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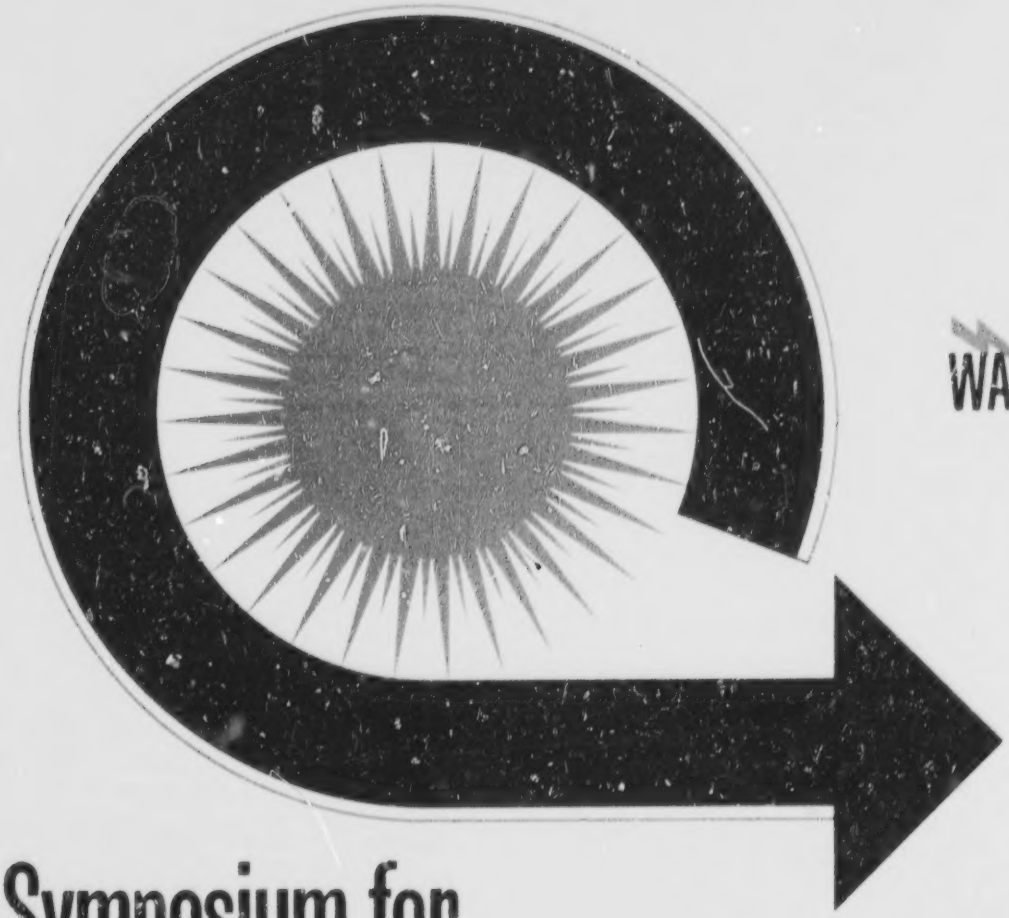

WATTec

Symposium for Public Awareness on Energy 1977

KNOXVILLE, TENNESSEE FEBRUARY 24, 1977

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ENERGY AWARENESS

Symposium for
Public Awareness on Energy, 1977

Knoxville, Tennessee
February 24, 1977

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The contents of the presentations at this symposium, and the opinions expressed in the discussions, reflect the views of the participants and do not necessarily reflect those of the individual sponsoring societies.

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Tennessee Society of Professional Engineers (TSPE)

In cooperation with:

Union Carbide Corporation--Nuclear Division
Energy Research and Development Administration

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FOREWORD

The objective of the Symposium for Public Awareness on Energy is to provide an information exchange among the members of the technical community and the public, civic, fraternal, service, and labor organizations on timely energy-related issues. The 1977 symposium was oriented toward state and local governmental officials in the southeastern states. Since it is these officials who have the responsibility for the development and actualization of local energy strategies, the program was directed toward providing information which would be of help to them in considering energy plans.

The symposium presentations featured speakers who are recognized in many facets of the energy field. A variety of views were expressed and a number of policy alternatives were suggested. It is hoped that the presentations provided the motivation for the audience to return to their respective communities with a new and expanded perspective regarding energy issues and policies. The private and public organizations represented at the symposium can continue to provide pertinent information to those who are interested.

This publication of the symposium proceedings was prepared from a verbatim record taken by the conference-reporting firm of Childers and Shelnutt of Atlanta. All speakers and participants knew and agreed that the record was being kept and that the proceedings would be published. The Symposium Committee appreciates the assistance of the Information Division of the Oak Ridge National Laboratory in obtaining the services of Childers and Shelnutt and in editing, composing, and printing the content of this proceedings. We also appreciate the services and assistance provided by the Oak Ridge Operations office of the Energy Research and Development Administration.

Thomas W. Waldrop, Chairman
Symposium for Public Awareness on Energy

INTRODUCTORY REMARKS

General Chairman J. W. Prados: Good morning. I would like to welcome all of you to this final session of WATTec-1977. I think I have probably welcomed most of you already; but in case some of you are here for the first time today, I am John Prados, General Chairman of WATTec this year.

Today's Public Awareness Symposium, in my opinion, is probably the most important part of our entire WATTec program, and we are deeply honored to have as our guests today a number of distinguished leaders in their communities from our neighboring states, as well as from Tennessee. We are delighted to have you with us today, and we hope that you will find this program both informative and enjoyable.

Again, I would like to encourage all of our participants to take advantage of the breaks in our program to view the exhibits upstairs in the Hyatt Regency lobby. Our exhibitors are one of the very important parts of this WATTec conference, and we hope you will support them by your attendance at their booths.

I would like now to turn the podium over to Tom Waldrop, who has organized this symposium and who will introduce our speakers for the morning.

Chairman Tom Waldrop: I want to express my welcome this morning, and particularly since our theme is **Energy In The Southeast**. I particularly want to express our welcome to those from our neighboring southeastern states who are here today as part of this symposium. We are going to get right into the program. I have a few housekeeping things I would like to cover here. We have a very tight agenda today, and we will plan to stay on schedule. I have asked each of the speakers to allow a few minutes at the end of their talk, if it is appropriate, for questions, and we will entertain questions at that time. I am sure that there will be comments that will want to be made during the symposium, and rather than have comments during the speaker's time, we have reserved the last part of the afternoon for anyone who wants to make comments. We'll give them an opportunity at that time. When you raise your hand for a question, we do ask that you identify yourself; and we have two microphones like this that the girls will bring to you if you raise your hand.

The two other subjects that we will entertain questions on late in the afternoon, rather than during the day, are (1) Energy Expo 82 (there are several people that will be here who are associated with it and will be glad to answer some questions; Jack Gibbons is one of them) and (2) the Energy Opportunities Consortium, which I am associated with. If you don't know, that is a consortium of the University of Tennessee, Union Carbide Nuclear Division, Tennessee Valley Authority, and the Knoxville–Oak Ridge business community. We can discuss that late in the afternoon.

1. ENERGY IN THE SOUTHEAST—A PERSPECTIVE

F. S. Patton

Chairman Tom Waldrop: I would like to introduce our first speaker, who is Mr. F. S. (Pat) Patton. I expect most of you know him as well as you know anybody else in this room. Pat is Manager of Design Engineering for the Union Carbide Corporation's Nuclear Division in Oak Ridge.

Following military service, Pat attended the University of Mississippi, and received a B.S. degree in Chemical Engineering, 1948; and an M.S. in Chemical Engineering from Louisiana State University in 1950. He was named to Tau Beta Pi honorary society, and has done further graduate work at the University of Tennessee in engineering.

He is a registered professional engineer in the State of Tennessee, and has served as president of the Oak Ridge Chapter and as state director of the Tennessee Society of Professional Engineers. He is a senior member of the American Chemical Society, and was a delegate to the 1958 Conference On Peaceful Uses of Atomic Energy in Geneva, Switzerland, where he presented a paper on uranium processing economics. He has authored or coauthored numerous classified technical reports. He is also a coauthor of the book *Enriched Uranium Processing*, published by Pergamon-MacMillan in 1964, which is considered an authoritative text in the field. Pat was recipient of the Tennessee Society of Professional Engineers Achievement Award for Tennessee in 1976.

He was chairman of this symposium in 1976, and will present this morning his perspectives on the vital subject of "Energy in the Southeast."

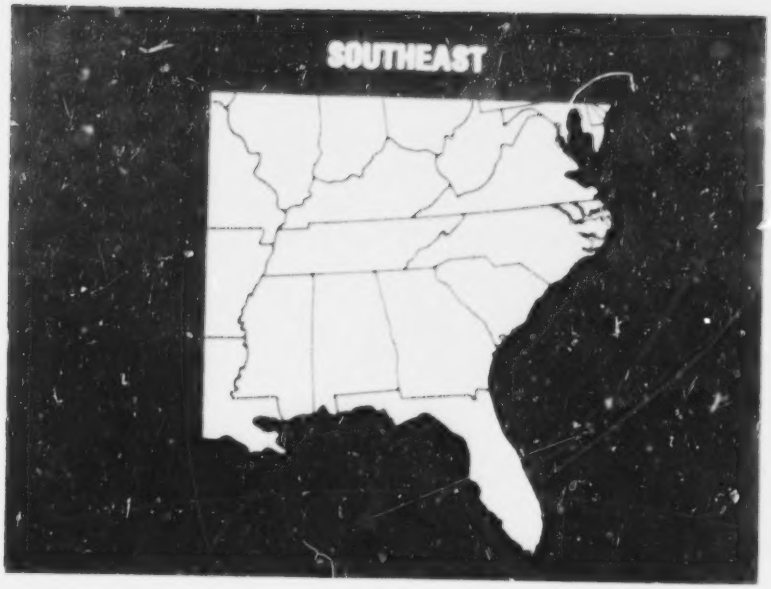
Mr. F. S. (Pat) Patton: Good morning. In my remarks to you this morning, I am going to speak to the energy characteristics of the southeastern states at present, and what their prospects are up through 1985.

Now, the southeastern states, the portion which I will be speaking to, are the nine states Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi (Slide 1.1).

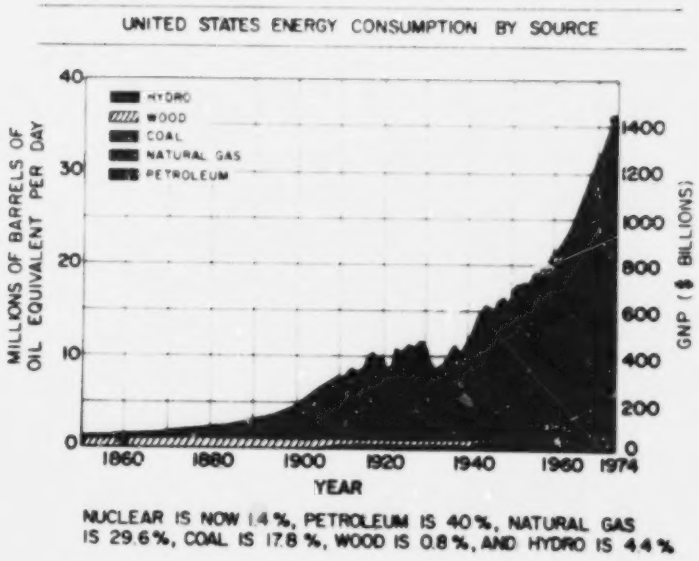
If we are going to understand energy matters for the Southeast, we must understand them in a context of how they fit into our country as a whole; because first of all we are Americans, and residents of Tennessee and other states second.

This (Slide 1.2) is a graph which shows the history of energy use in the United States over a period of a hundred years. This gray part is coal, the pink is natural gas, and the brown is oil. These black dots here are gross national product or national income.

You can see that there has been a rough correlation between the growth of energy and the growth of national income. I point out to you that there has not been much net growth in coal for a considerable period of time. Back at the end of World War II most of our energy was derived from coal, but since that time there has been a tremendous growth in energy use and it has been practically and entirely in oil and gas.



Slide 1.1



Slide 1.2

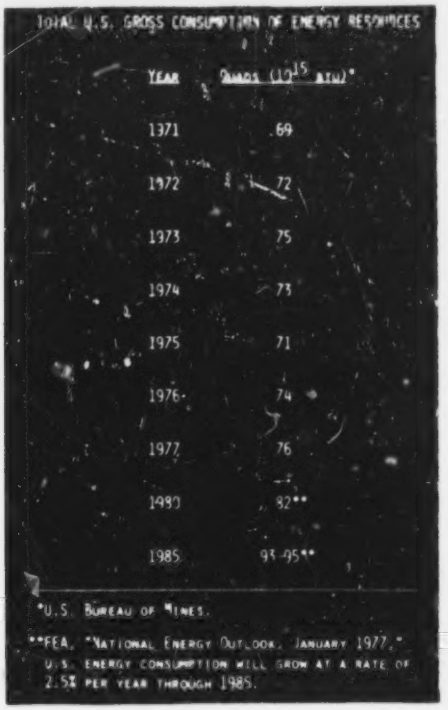
This oil and gas has fueled a period of prosperity for this country, which is unique in all history. The average American today in this 30-year span, even after you make allowance for inflation and increased taxes, is twice as well off as the American of 1950.

I can tell you today that our use of oil has grown such that the United States now uses more oil than the whole world used to fight World War II. I can tell you that the energy content of the oil we import exceeds the energy content of the coal we produce. I can tell you that since 1970 the amount of imported oil we have brought into this country has had an impact to where we are importing twice as much and the cost is ten times as much.

It is sometimes suggested that perhaps we could go forward with a single strategy: nothing but coal to substitute for that oil and gas. That really would not be a practical matter, to make a complete substitution. We would have to mine coal equivalent to somewhat more than the whole world's current production.

Perhaps you have heard that coal use went up 2½% last year. In reality what happened was eastern coal production went down. That is, the high-fuel-content coals: Western coal, which has a lower fuel content (some of it has about the same fuel content as firewood), went up to give that net gain in tonnage.

I have here (Slide 1.3) a listing of the United States' consumption of energy by recent years and projected into the future, and this is in terms of quads, or million billion BTUs. The thing I want to point out to you, rather than the absolute value, is the change. We steadily built up until we peaked in 1973 with 75 quads. Then, as a result of the Arab oil embargo and the quadrupling of price by the OPEC countries, concurrent with a worldwide depression, it went down in 1974 to 73 quads, to 71 quads in 1975, turned back up in 1976 with a recovery, and it is projected to be 76 or 77 this year.

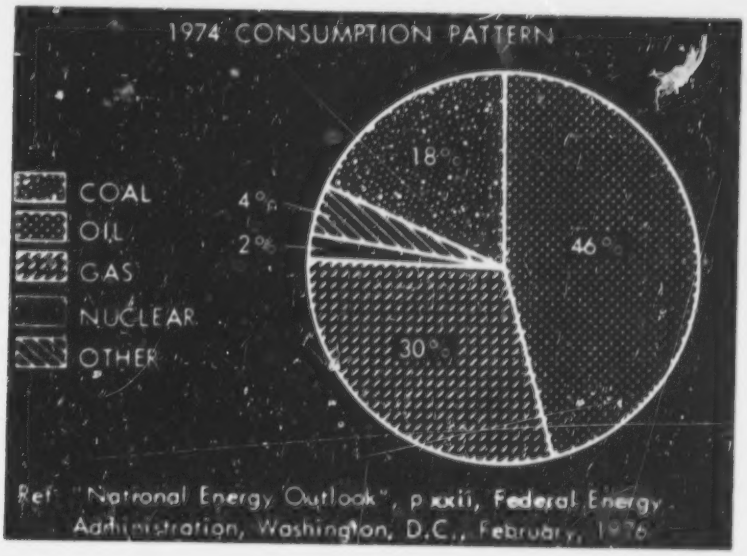


Slide 1.3

This January, the Federal Energy Administration has projected a growth up until 1985 of 2 [illegible] per year, which would give us an amount of 93 to 95 quads, or very close to some 20% growth.

Here (Slide 1.4) is a pie chart which was for 1974 and which I want you to get better fixed in mind. Forty-six percent of our energy for the nation as a whole in that year was from oil, 30% gas, 18% coal, 4% hydro, 2% nuclear. This year, nuclear will have grown to 4% and natural gas will have decreased to about 28%.

Since we have such a heavy dependence on oil, it is in order to look at it more closely in terms of a world context. You can see here (Slide 1.5) that in just a little over ten years the world's use of oil has more than doubled.



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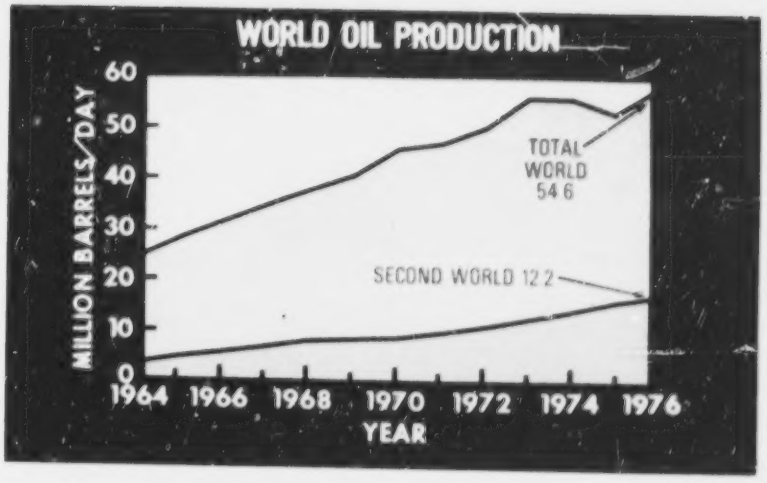
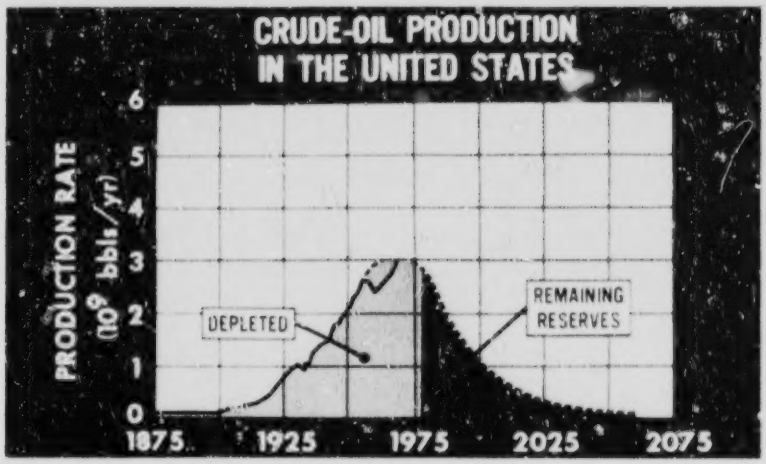


Slide 1.5

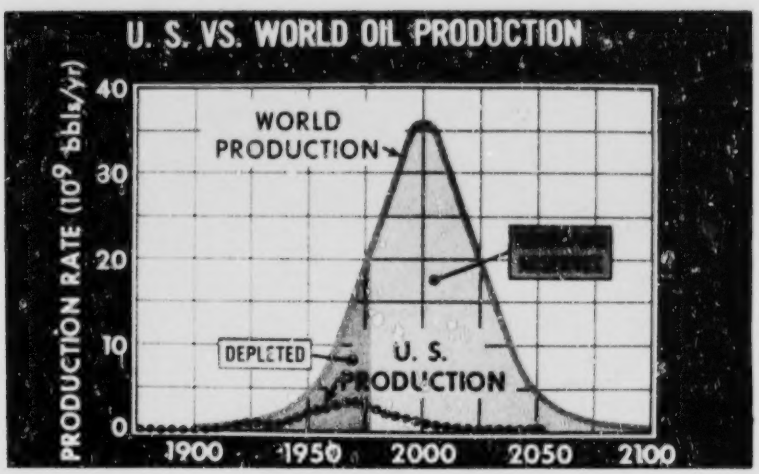
This (Slide 1.6) is a statistical projection which was drawn up by Dr. M. King Hubbard, the eminent geologist. This projection of his would indicate that originally the United States had as a natural resource in the ground some 200 billion barrels of oil. That seems like an immense number, but let me tell you we have extracted 120 billion barrels, and if we had not imported an accumulative total of some 25 billion barrels, this brown area would be significantly less.

Today we are fast approaching the point where the amount of oil we have to import will exceed that which we produced domestically. Since 1970 our production has decreased 10%. This is in spite of the fact that there has been an enormous increase in the number of wells drilled.

Now, as I said, we have an increasing dependence on imported oil, so it is in order to take a look at what the situation is in the world. I have taken the liberty of taking this chart right here and superimposing that on Dr. Hubbard's chart for the world (Slide 1.7). His projection would indicate that the world had originally in the ground as a resource some ten times the amount of oil which the



Slide 1.6



Slide 1.7

United States had, and we can see here the United States. While the United States has used up 60% of its natural reserve of oil, the world has only used up about 18%, and this green is the remaining reserve. So, we might ask ourselves, why is there an oil crisis?

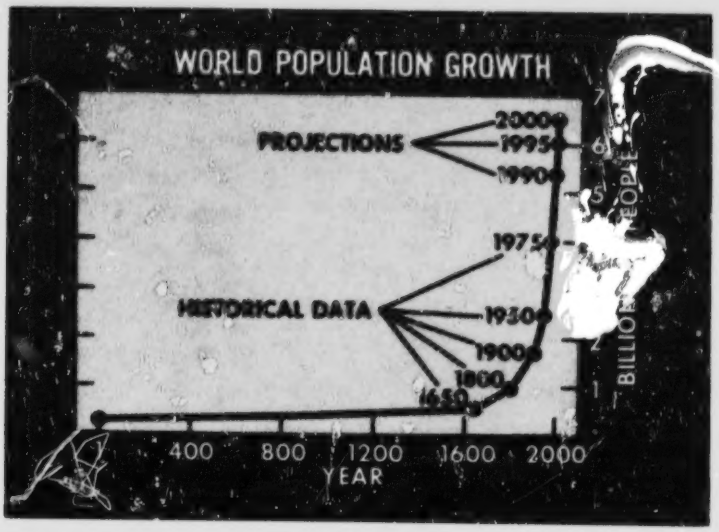
In a purely physical sense, there is no reason for there to be an oil crisis for 10, 20, perhaps 30 years. At the present time the world demand for oil is 20 billion barrels a year, its capacity to produce is 25 billion barrels. So, why should there be a physical reason for an oil shortage? It is much more likely, though, that we are going to have some kind of a crisis much earlier than that time span of 20 or 30 years, brought on by political and economic considerations by the OPEC states.

What kind of thing would bring it on? Well, if we have drastic inflation in this country where they perceive that it is in their best interest to keep this valuable oil in the ground, rather than trading it off for dollars of decreasing value, we must ask ourselves, who owns all of this reserve of oil? Let me tell you, it is not us. The United States only has 5% of that. The rest of the capitalist democracies, Western Europe, Japan, Canada, and Australia, have another 5%. The King of Saudi Arabia, a little country with 8 million people, owns one-fourth. The Shah of Iran and the ruler of Kuwait together own another one-fourth. The rest of the OPEC states, about 15%; China and Russia about 25%. It doesn't bode well for us.

You might ask yourself, why does this have to go up at such a sharp rate and come down at such a sharp rate? Why can't we smooth it out and make it last a longer period of time? The reason is because of the tremendous increase in population on earth.

In 1950, there were 2½ billion people on earth (Slide 1.8). At that time the State Department and the United Nations predicted that by the year 2000 there would be 4 billion people. There were 4 billion people in 1976. Their current projection is that by the year 2000 there will be 6 to 7 billion people.

The world's technology is largely controlled by the capitalist democracies in all areas except some weapons systems. That technology is based on oil and gas as primary fuels. Ninety-eight percent of the patents in the world, outside of the communist area, come from the United States,



Slide 1.8

Western Europe, and Japan. The rest of the world must take what we produce or do without. It is not possible for someone in South America to decide they want to have trucks that run on something other than the fuels that we design them for.

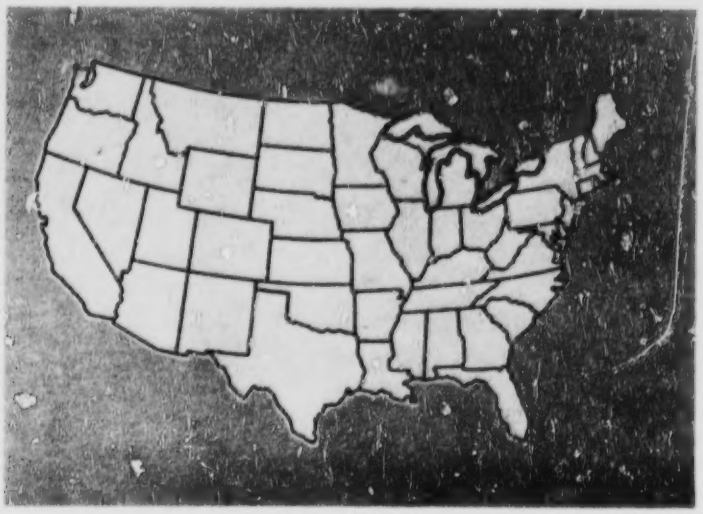
So, this tremendous increase of people, even though they are very poor people, has an impact on the demand for oil and gas. If they have any degree of affluence, the demand goes up many fold.

This period of time between when 10% of this oil was used up and when 10% is left (Slide 1.7) has been styled the Age of Petroleum. This was alluded to by our speaker last night, Representative Thornton – that we are using it all up in four to five generations. There were 10,000 generations before us, there could be 10,000 generations after us. We have a moral responsibility to use this oil well. It's a one time thing, it took millions of years to form and will never come again.

I can pose a question to you in this vein. Let's suppose somehow it was possible for all the people on earth, those billions of poor people out there in the Third World in underdeveloped countries, to have an American standard of living. Of course, based on our consumption of oil and gas, how long would this Age of Petroleum be? A little over six years. That tells you it is impossible for the rest of the world out there in the Third World to ever have an American standard of living based on purely oil and gas technology. We have a moral responsibility for energy conservation, and the development of technologies which are not based on these fuels.

Let's look at these figures for the United States: 46% oil, 28% gas – what does that mean? The United States is not homogeneous in an energy sense, that is, the arithmetic results that you get when you take widely different energy characteristics or regions. If we look up here (Slide 1.9) in the Northeast, New England, in this coastal strip encompassing New York City, Philadelphia, and Washington, on down through there, that is where 20% of our people live on 3% of the land. There are no significant remaining natural energy resources in that area. Over 80% of the energy is on the basis of oil. It must be brought in by sea, whether it comes from Texas or Saudi Arabia. Only 2% of the energy in New England comes from coal.

Perhaps you have heard that Sweden is the energy conservation model of the world. Let me tell you, the people of Sweden on a per capita basis use more electricity than the people of New York



Slide 1.9

State. I could also tell you that in 1974 per capita use of all energy in Sweden was not much less than New York State or the New England states. It is a fact that some parts of the country use enormously more, and for a very good reason.

If we look down at West Virginia, Kentucky, western Pennsylvania, Ohio, Indiana, and Illinois, those seven states in 1975 produced 80% of our coal. Not surprisingly, 80% of the electricity in that region is made from coal. In fact, in West Virginia, Kentucky, and Pennsylvania, over 95% of the electricity is made from coal. In West Virginia, in comparison with the New England states, only 17% of the energy comes from oil, and about two-thirds from coal. Isn't that a striking difference?

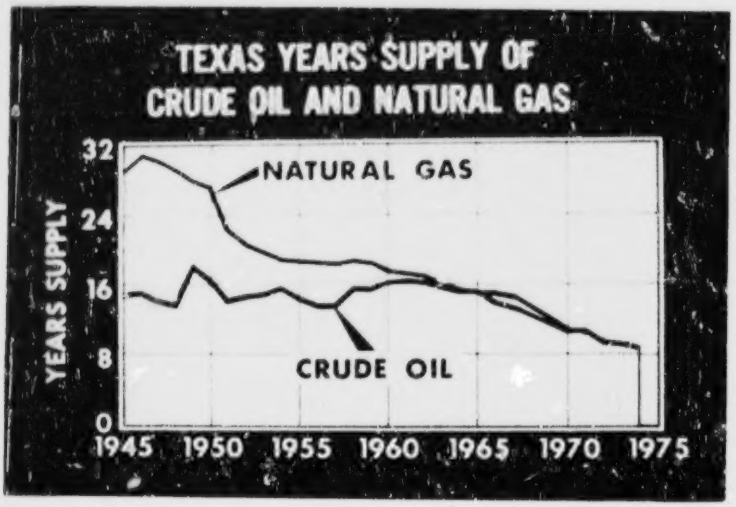
If we look down here in this region, Louisiana, Texas, Oklahoma, Kansas, and New Mexico, they produced 90% of the natural gas in this country. Eighty percent of the electricity is made from natural gas. In Texas and Louisiana, it's 90%. Ninety-eight percent of all energy used in Louisiana and Texas is oil and gas, a big difference from this country as a whole.

I could tell you that Texas is the biggest electricity-producing state in the country. It has a population of 12 million; it produces 20% more than California, which has 22 million. Twelve million people live in Texas; 12 million people live in New England.

The use of energy on a per capita basis is nearly three times greater in Texas than it is in New England. Why? Because this is where a great deal of our national energy resources come from; it takes energy to produce energy. Due to past circumstances, this was the economic thing to do; and one thing we must be very careful of, as Representative Thornton alluded to last night, is not look for someone to blame or for a cause for inequity.

We live in a period of ceaseless change, and what was in order yesterday may not be in order tomorrow. The industrial use of energy in Texas is over ten times that in New England. Now, that is today. What about tomorrow in Texas? The situation is going to drastically change.

Right now Texas is the best state for business in the country, but look at this (Slide 1.10). This is a projection of Texas oil and gas for the future, drawn up by the Texas Railroad Commission, which controls those things in Texas. The Texas Railroad Commission predicts that by 1985 Texas will be a net energy importer. That is the reason they want to have a superport in Texas and one in

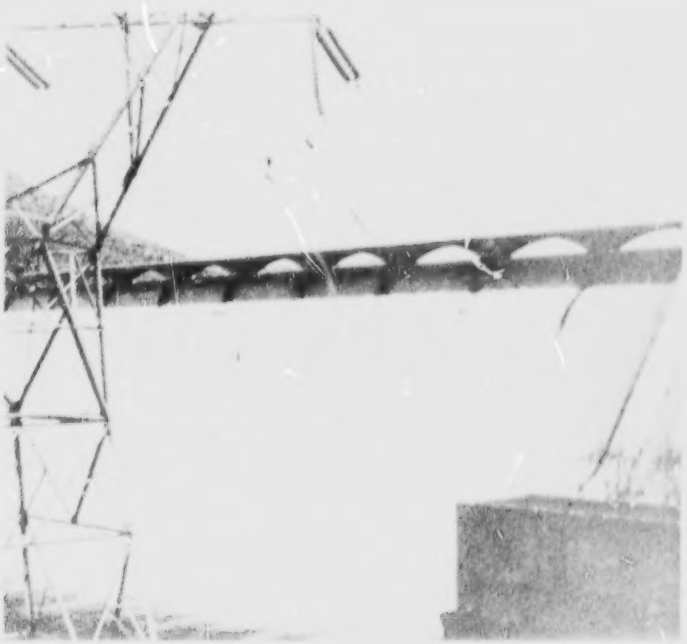


Slide 1.10

New Orleans – so they can supply with imported oil those petrochemical industries that located in that area when it looked like the supplies would be endless.

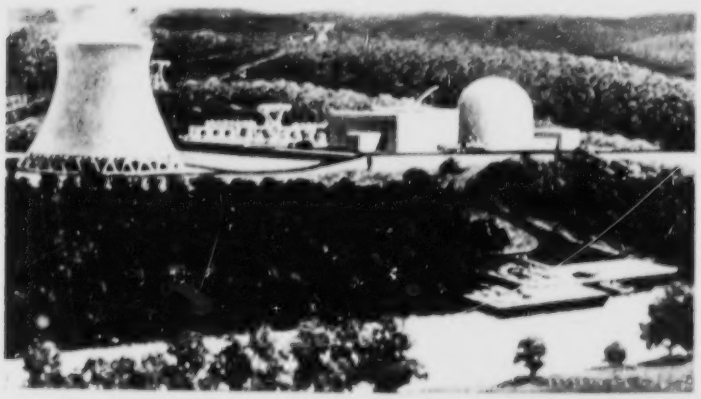
Let's turn now to the Pacific Northwest (Slide 1.11). That is where 50% of the hydro power in the country is. And by hydro power, of course, I mean dams (Slide 1.12). You have a situation there where in this region, Washington, Oregon, Idaho, and Montana, the vast bulk of all the electricity is from dams. In Oregon it's 99%. Because of the drought in that area, they are likely to lose 25% of their electricity.

Slide 1.11



Slide 1.12

Well, what about nuclear power? (Slide 1.13). This (Slide 1.14) is the location of all the nuclear reactors in operation, under construction, or affirmatively planned in this country. You will note that the vast bulk of them are in the eastern part of the country. You might also look, and from this chart come to the conclusion that there were vastly more nuclear reactors in the Northeast than the Southeast. It turns out that that is not true. These that were built up in the Northeast, many of them were the first generation; these were smaller reactors. The practice was to put one reactor at a site. The Southeast's nuclear energy is just starting to come on the line; the practice is for bigger reactors and to group them, like at Brown's Ferry where there are three.



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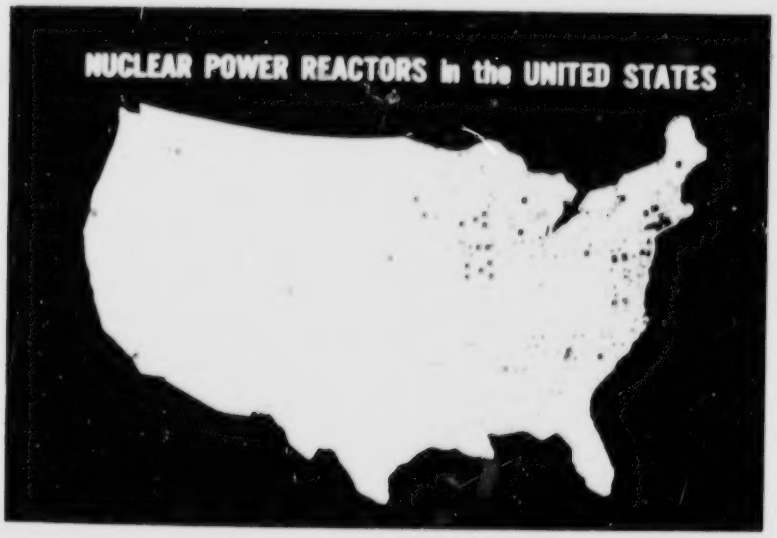


Slide 1.14

I can tell you, for these nine southeastern states by 1985, if all of our plans are fully implemented, there will be more nuclear energy produced here than all 22 states west of the Mississippi. Tennessee will have more nuclear power than California Tennessee with 4 million people, California with 22 million people.

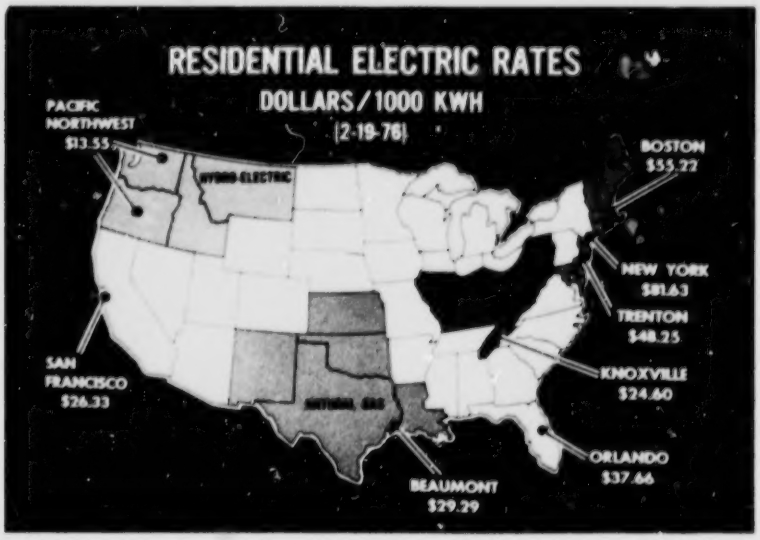
So, proportionately, nuclear power is of more importance to the Southeast than to some other parts of the country. Ten western states in 1985 will have no nuclear power, because that fits them economically. You will notice there are no nuclear power plants planned up here in the heart of the coal region. It doesn't make good economic sense. You put those in places where you are not close to a source of indigenous energy.

At the present time, nuclear power for the country as a whole is about 9% of the electricity, in the Southeast nearly 20%. By 1985, where for the country as a whole it will be 23%, it will be 40% for the Southeast.

What does all of this add up to in the price of electricity? Look at this (Slide 1.15). Where you have the hydro power, last winter the price for a thousand kilowatt hours for a home owner was $13.55. Over on the other coast, it was four to six times as much. Simply by the fortuity of whether you happened to live on the east or west coast.

Look down here in the TVA area: $24.60. Well, that was last winter. What has happened since then? I can tell you that the price in this area has gone down from $24.60 to $23.60. Up here in New York City, it has gone up from $81 to over $90.

Let's look at the TVA region where we live (Slide 1.16). The TVA power region 80,000 square miles to serve 6 million people. TVA is a natural energy resource of this region. TVA produces power here to such an extent there are only two states, Texas and California, and seven foreign countries that produce more power than TVA. It doesn't matter where you live in this region, the



Slide 1.15

Slide 1.16

price is essentially the same. That is not true in some other places. New York State (60,000 square miles), if you live in Niagara Falls you pay only about one-third as much for electricity as if you happened to live in New York City. Again, don't make the mistake of attaching fault or blame to any of these circumstances. They arise because of fortuities, what was economic and in order in the past. I firmly believe all the people in this country as groups are well intentioned.

I can tell you with regard to TVA, their nuclear power program is such that by 1985 the energy of this region will have doubled. It will be 60% nuclear; and it will be a bastion of strength, not only to this region, not only to the Southeast, but to the nation as a whole, because it has a capacity through transmission lines to serve power to many places. What does that mean? Sixty percent of over 200 billion kilowatt hours. If you took all the oil that Oklahoma produces and burned it and converted it into electricity, it would be less electricity than TVA will be furnishing here from nuclear power in 1985. It is kind of hard to perceive, and maybe you don't get an immediate rise when people talk about a moratorium on nuclear power. But look at it in this context. How would the people of Oklahoma look upon a moratorium on the production of oil from their state? The impact here economically and for the Southeast region is equivalent. There is a tremendous program of power plant expansion throughout the Southeast (Slide 1.17).

Slide 1.17

We are ready to turn to look at the characteristics of these individual Southeastern states (Slide 1.18). It is not only the states which have a stewardship for energy production in the South. Of the 13 major utilities, the biggest is TVA, second is the Southern Corporation, third is Duke Power, and so on. These organizations have a responsibility by their charter to work in concert with the state officials and other agencies to plan and produce power. They also work in concert with the other utilities of the nation through the National Electricity Reliability Council (Slide 1.19).

Slide 1.18

Slide 1.19

You see here (Slide 1.20) their capacity collectively in the Southeast. Now it is something like a hundred thousand megawatts and production of nearly 400 billion kilowatt hours in sales. Plans under way will double this by 1985. It is based on coal (high-sulfur coal) and on nuclear power. It is too late to make a bunch of changes that would give that equivalent power by doing anything else. All you can do is take actions which limit or stop some of this, and that would mean less power for this region and for the whole eastern part of the nation.

Here I have the states listed (Slide 1.21) for coal production. You can see right here that Kentucky produced 140 million tons of coal (it is the nation's leading coal producing state); the vast bulk of that is what is styled high-sulfur coal. Virginia produced about 33 million tons, Alabama 19 million tons, and Tennessee 8 million tons, for a total of 200.

ELECTRIC POWER
SOUTHEASTERN U.S. 1975

	Power Group	System Capability (Millions of kW)	Sales (Billions of kWh)
APPC	APPALACHIAN POWER CO. (AEP SUB.)	4.7	24.2
CPL&LC	CAROLINA POWER & LIGHT CO.	7.1	29.1
DUPC	DUKE POWER CO.	12.4	47.1
FPCO	FLORIDA POWER CO.	5.7	23.9
FP&LC	FLORIDA POWER & LIGHT CO.	8.9	34.1
KEPC	KENTUCKY POWER CO. (AEP SUB.)	2.1	9.6
KEUC	KENTUCKY UTILITIES CO.	2.2	9.5
MP&LC	MISSISSIPPI POWER & LIGHT CO. (MSU SUB.)	2.8	8.6
SCPSA	SOUTH CAROLINA PUB. SERV. AUTHORITY	4.2	14.3
SEPA	SOUTHEASTERN POWER ADM'N. (USDI)	2.4	7.7
TVA	TENNESSEE VALLEY AUTHORITY	26.7	100.4
TSC	THE SOUTHERN CO.	20.2	75.5
VEPCO	VIRGINIA ELECTRIC & POWER CO.	8.7	31.5
	TOTAL CAPABILITY & SALES	132.1	585.5

NOTE: POWER GROUPS HAVING LESS THAN ONE BILLION KILOWATT HOURS/YEAR SALES ARE NOT LISTED.

Slide 1.20

COAL PRODUCTION & CONSUMPTION IN THE SOUTHEAST

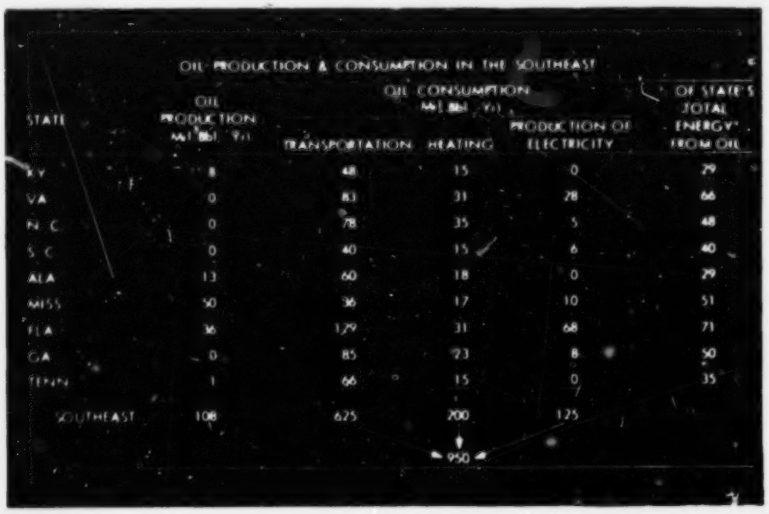
STATE	COAL PRODUCTION (Millions of Tons/Yr)	COAL CONSUMPTION (Millions of Tons/Yr)		% OF STATE'S TOTAL ENERGY FROM COAL
		ELECTRICITY PRODUCTION	INDUSTRIAL USE	
KY	140	21	4	48
VA	33	4	2	15
N. C.	0	19	2	36
S. C.	0	6	1	23
ALA	19	16	9	40
MISS	0	1	0	5
FLA	0	6	0	8
GA	0	10	0	20
TENN	8	17	2	34
SOUTHEAST	200	100	20	

Slide 1.21

The Southeast used 120 million tons; 100 of that for electricity production, and 20 for industrial uses. Let me tell you, the industrial uses are going down, not only in the Southeast but for the country as a whole. There has been a trend for many years, that the use for electricity production is going up. It is my perception from a review of the annual reports of all of these utilities, the studies of the National Electricity Reliability Council and the Edison Electric Institute and other organizations, that the demand for coal in the Southeast will increase from 120 million tons to 180 million tons by 1985.

You can see that the dependency of these several states on coal varies graphically. Here is Kentucky, 48% of its energy is from coal, all the way down to Mississippi, 5%, and Florida, 8%.

This is the situation on oil production and consumption (Slide 1.22). You can see the Southeast consumes about ten times as much oil as it produces; Kentucky produces a little, Alabama a little, Mississippi a considerable quantity, and Florida some. You see the bulk of this oil use is for transportation. That will increase by 1985, primarily due to the increase of population, a part of which comes from migration. It is my perception that the oil requirements for heating will not increase; the oil for production of electricity will not increase, indeed, it may decrease some.


OIL PRODUCTION & CONSUMPTION IN THE SOUTHEAST
STATE
OIL PRODUCTION (MILLION BBL / YR)
OIL CONSUMPTION (MILLION BBL / YR)
TRANSPORTATION
HEATING
PRODUCTION OF ELECTRICITY
% OF STATE'S TOTAL ENERGY* FROM OIL
KY 8 48 15 0 29
VA 0 83 31 28 66
N C 0 78 35 5 48
S C 0 40 15 6 40
ALA 13 60 18 0 29
MISS 50 36 17 10 51
FLA 36 179 31 68 71
GA 0 85 23 8 50
TENN 1 66 15 0 35
SOUTHEAST 108 625 200 125
950

Slide 1.22

Look at the dependency on oil of these states, how drastically it varies. Only 29% of Kentucky's energy is from oil, whereas Florida is 71%. Florida is like the New England states. It has a heavy dependency on imported oil. At the same time, Florida has the lowest per capita use in the country, much less than Sweden. These things have come about by fortuities. When these other states strengthen their utilization of coal and nuclear power, they decrease the vulnerability of Florida and the New England states—places where it is economic to use that oil. If we don't do that type of thing we are going to end up with deprivation and unfair suffering on the part of those people who have been put in that position by geographic circumstances.

This is the situation on natural gas (Slide 1.23). You can see that the Southeast produces again about 10% of its natural gas; the big producers in the Southeast are Kentucky and Florida. Look at this decrease over the last three years. The decrease of availability of natural gas for the Southeast has been about 20%, and again, the dependency is not equal. It is low in places like Virginia and North Carolina, high in Mississippi.

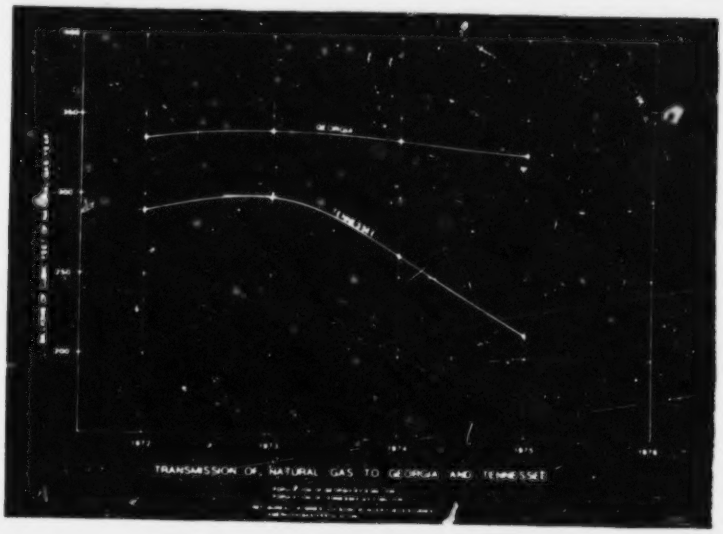
NATURAL GAS PRODUCTION & CONSUMPTION IN THE SOUTHEAST

STATE	NATURAL GAS PRODUCTION (Billions of Ft³/Yr)	NATURAL GAS CONSUMPTION (Billions of Ft³/Yr)				% OF STATE'S TOTAL ENERGY FROM GAS
		1972	1973	1974	1975	
KY	71	265	254	231	213	20
VA	7	160	159	149	121	12
N. C.	0	168	161	143	115	10
S. C.	0	151	150	137	123	16
ALA	27	285	270	281	264	19
MISS	77	388	307	283	230	43
FLA	38	300	313	290	289	16
GA	0	336	344	335	326	27
TENN	<1	283	299	263	217	20
SOUTHEAST	220	2336	2257	2116	1898	

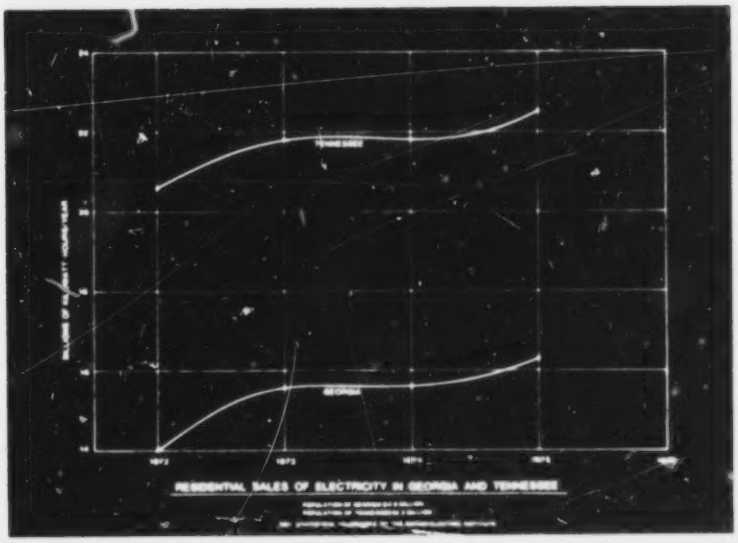
Slide 1.23

I am going to take two of these states just to highlight the differences, and the two I am taking are Georgia and Tennessee. This is the natural gas which Georgia has gotten (Slide 1.24), and they don't produce any; it all comes from Texas and Louisiana, over the period from 1972 to 1975. Here is what is happening to Tennessee. The population of Georgia is about 10% more than in Tennessee, and it isn't that there is anything back of this difference, other than fortuity. My perception is that the contracts for the gas lines in Georgia happened to be with fields that have good reserves, those for Tennessee didn't, and as a consequence we happened to have much less natural gas proportionately in Tennessee than in Georgia. We need to recognize those things; don't look for fault.

Look at the situation on use of residential electricity (Slide 1.25). Here is Georgia with a bigger population. Look how much more residential electricity is used in Tennessee. With 10% fewer people, we use 40% more electricity in our homes. That is the difference.

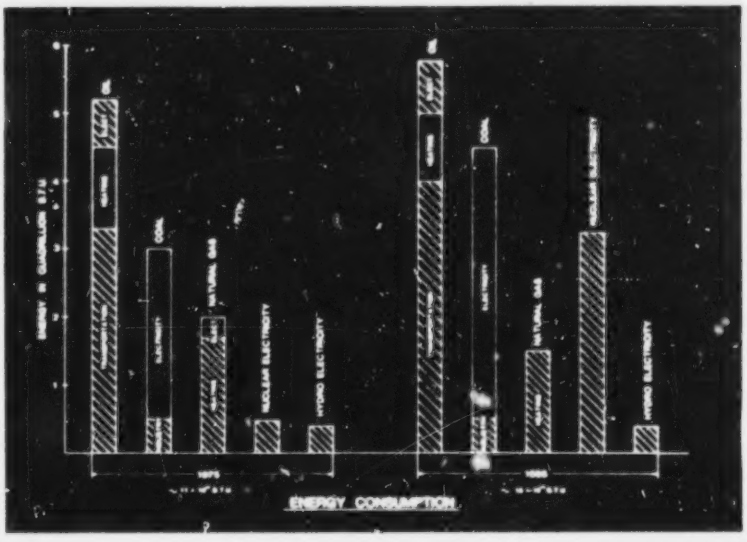


Slide 1.24



Slide 1.25

Here is my perception with regard to the total energy use in the Southeast (Slide 1.26). In 1975, the Southeast used 11 quads out of a national total of 71, about 15%. The projection is that will be 15 to 16% in 1985, or something like 15 quads out of 93. Look at the change in the makeup. Very little increase in oil, and what there is, is due to an increase in population, which impacts on transportation. Coal use will go up very significantly: some 60 million tons a year. Natural gas declines. Nuclear electricity increases many fold. Hydro stays about the same.



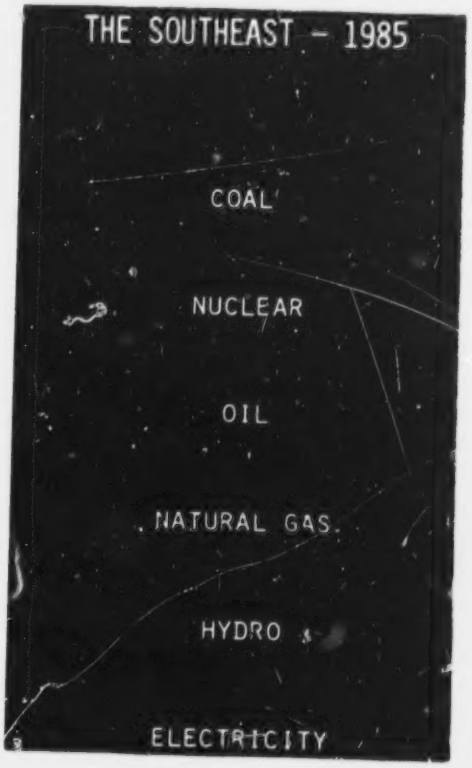
Slide 1.26

Thus, in summary (Slide 1.27), the prospects are:

1. Coal is a vital energy for the Southeast, that is, high-sulfur, eastern coal. Anything, whatever its nature, which results in a lessening of the availability or economic practicality of coal will negatively impact the economics of the South.
2. As for nuclear power -- whereas 23% of the electricity for the country as a whole will be nuclear in 1985, it will be 40% for the Southeast, and about 60% for TVA. So, we are very heavily dependent on that.
3. Oil, very little increase.
4. Natural gas, decrease.
5. Hydro, the same.
6. For electricity, as a total, as Dr. Weinberg indicated yesterday, about one-third of the energy of the nation as a whole will go into electricity production in 1985. In the Southeast it will be over 50%, and in the TVA area about two-thirds. So, the basic difference in the characteristics of the Southeast and the nation as a whole is a much greater utilization of electricity.

In closing, let me ask that all of us remember: first of all we are Americans, second we are citizens of these several states; and we all want to make our country strong. Not everything can be done by the federal government. There is a great deal that needs to be done on a local level to strengthen the energy picture. If you strengthen your community in an energy sense, if you strengthen your state, if you know what is going on in neighboring states, if you can decrease pressure for the country as a whole on oil and gas, you make things better for those parts of our country which will continue to have a heavy dependence on these resources.

That concludes my remarks. Thank you.



Slide 1.27

2. A SUMMARY OF FEDERAL ENERGY PROGRAMS

John H. Gibbons

Chairman Tom Waldrop: Our next speaker is Dr. John H. Gibbons, director of the University of Tennessee Environment Center. Jack has earned and enjoys a national position in the field of energy and environment, as most of you know. After receiving his doctorate from Duke University in physics in 1954, he joined the Oak Ridge National Laboratory (ORNL), and did research on nuclear reactions pertinent to nuclear reactor design and to understanding the mechanism of heavy element synthesis in the stars. In 1965 he became a group leader in nuclear geophysics, and in 1969 director of the Environmental Study Project. In 1970 he became director of the ORNL National Science Foundation Environmental Program. In 1972 he joined the University of Tennessee Environment Center, but was quickly enticed to Washington as Director of Energy Conservation in the Federal Energy Administration. He returned to the University of Tennessee in 1974 after one year in Washington.

He has served or is serving on dozens of advisory and working committees of federal agencies and offices; all are related to the subjects of energy and environment. His participation in such committees has covered the past five years, those years during which the energy picture has changed from plenty to some. He is published widely and is the most sought-after speaker in our area. Jack has a broad participation as a consultant, advisor, and leader in many civic, professional, industrial, and cultural organizations; and he is one of those people who contributes to the highest level in all. No one is better qualified to summarize for us today the federal energy programs.

Dr. John H. Gibbons: You will note that Tom said that ever since I have been working with government, things have been getting worse. As my wife said, the harder I work, the behinder I get. Let me pick up on Pat's presentation, and remind you that to understand where we are and to gain a vision of where we may be going, it is important to know where we have been. So I will try to remind us all of the historical context first, and then bring us up to the present.

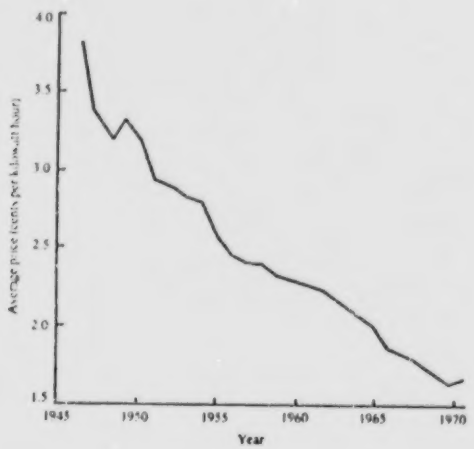
In the post-World War II era, especially the two years immediately following World War II, we returned to a situation that had existed for nearly 200 years: that is, the cowboy economy. We were a nation enchanted with technology. It had proved to be the constant cornucopia of new delights for us: it got us out of war, it provided seemingly infinite benefits. We felt that material resources were essentially infinite and also at our bidding. Energy was plentiful and cheap. Coal was constantly offset by oil and gas; and so we even had coal resources lying fallow. The nuclear promises of fission and fusion were so golden that there was serious speculation of unmetered electricity before the turn of the century. Prices for energy fell as our technology advanced, and this was aided by generous private and federal research and development support.

We had a de facto national policy operating during that period. It was to keep energy prices subsidized: for example, through mining and exploration tax benefits, through the allowance of unlimited imports, and through the regulation of price. The price of natural gas, for instance, was regulated well below its shadow price or real market price. There was also a lack of

regulation, or at least a laissez-faire attitude, about many external costs that operated in the energy system, particularly those of environmental quality and human health and safety. We therefore had a de facto policy of subsidy; and added to that subsidy policy was one in which we strongly underwrote the development of the other new energy system: nuclear energy. So as a nation we added that policy to our previous policy of subsidization.

Then came the coal depression, driven by the threat of cheap nuclear power, by the low price and availability of foreign oil, and by the impact of diesel technology on the railroads which rather quickly removed one of the major remaining markets for coal. Finally came a near coup de grace – the environmental health standards which were brought in during the 1960s and early 1970s and which reflected obviously very real and large external costs to the market that were being added to the price of energy.

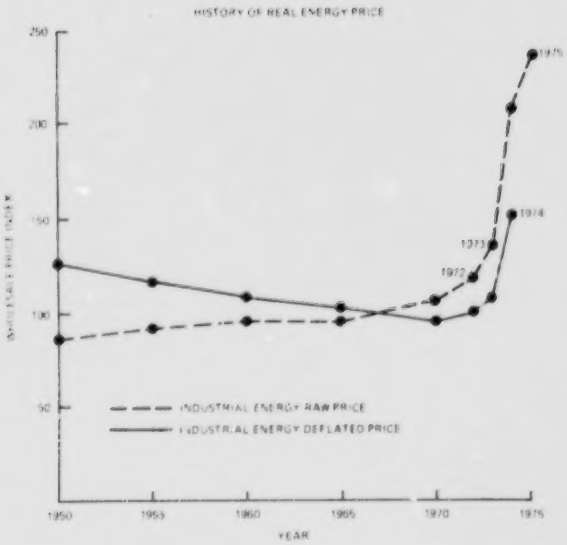
Thus, our second major post World War II national energy policy was to recognize the existence of major externalities in the price of energy, and to remove the subsidies and move closer toward true, full-cost pricing of energy. This had its impact in terms of price. The price of energy began to turn around. Let's see the first view graph (Slide 2.1). This is a curve of electricity price, deflated to take out inflationary effects from the end of World War II until 1970. You can see why people said we were headed toward unmetered power.



Slide 2.1

The next slide (Slide 2.2) indicates, however, what happened at about that same time. As the curve was falling (the solid line is the deflated price), you see there was a turnaround about 1970. It flattened out and made its turn upward. Now, the major turn upward had to do with things that happened a little bit later on. But the flattening of the real energy price and its turnaround toward higher values was generated by those things that happened in the late 1960s and early 1970s that were essentially domestically not exogenously determined. Because of the controls put on environmental emissions and the rise of the price of energy, there was an accelerated move toward natural gas. The record shows that we converted plant after plant from coal burning, and even some from petroleum burning, over to natural gas.

The demand for energy accelerated then from about 2% in the 1950s to well over 3% in the 1960s. This was driven by high population growth, and by relatively high growth in disposable personal



Slide 2.2

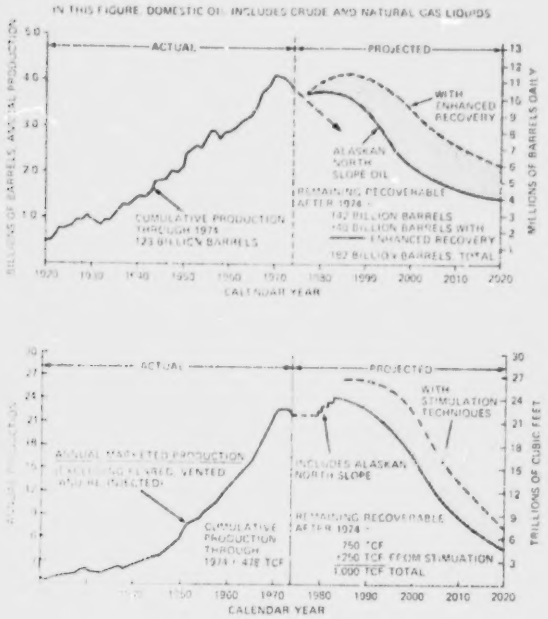
income. Imports, particularly of petroleum, rose from essentially no imports in the early 1960s to 30% imports in the early 1970s.

Then came the Yom Kippur war. The war coincided with the OPEC shift in world price, moving from a very low price that reflected a small profit on the actual cost of production of Middle East oil, to a price that reflected more closely a so-called shadow price for oil—that is, the price for oil that is competitive with other kinds of energy sources. The result of that sudden traumatic event was one of curtailment in the emergency that was mislabeled conservation. The thought of independence was suddenly raised for our nation. We suddenly recognized that we had moved from essential independence to a position of rapidly increasing dependence on foreign energy sources. There were even suspicions of conspiracies, and we searched quickly around to see who was at blame, without thinking about ourselves and our own habits.

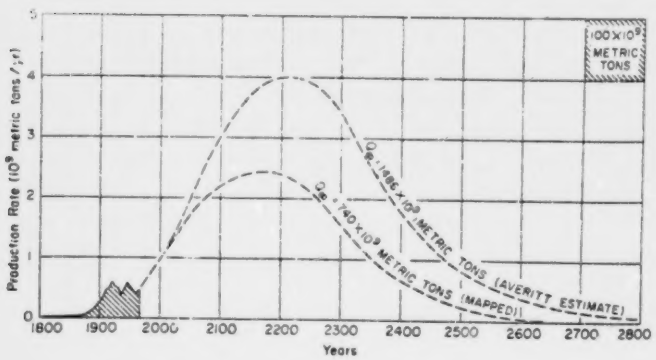
In a way there was a new policy every day during those periods. But at least the gift, the very important gift from the OPEC nations (I called it that then and I still do) caused us to back up and look at our situation with a little bit more attention to what was happening in the long pull.

The next slide (Slide 2.3) is a repeat of one of Pat's slides. It shows time across the bottom axis, and the vertical axis is production. The upper curve is petroleum and the lower curve is natural gas, and this is for our domestic supplies. You see we are rolling over the peak, and in fact are beyond the peak for natural gas. We are essentially on the peak for oil. The difference in the arguments is only a matter of a few years, not a difference in substance.

The next curve (Slide 2.4) is King Hubbard's; you might call it the Hubbard heretical process perhaps, at least it was in those days. Here Hubbard describes the yield of fossil fuels over a period of time. Yield goes up rapidly until price begins to catch up because more expensive means are required to extract the resource. Finally, the mining of the resource drops off as the price grows higher and higher and other competitive things take over. The shadowed area on the left is about where we were in the case of coal. So, there seems to be lots of coal, but as Pat pointed out if you start making petroleum and gas or synthethic petroleum and gas out of this coal, you find that it disappears in an alarmingly short time.



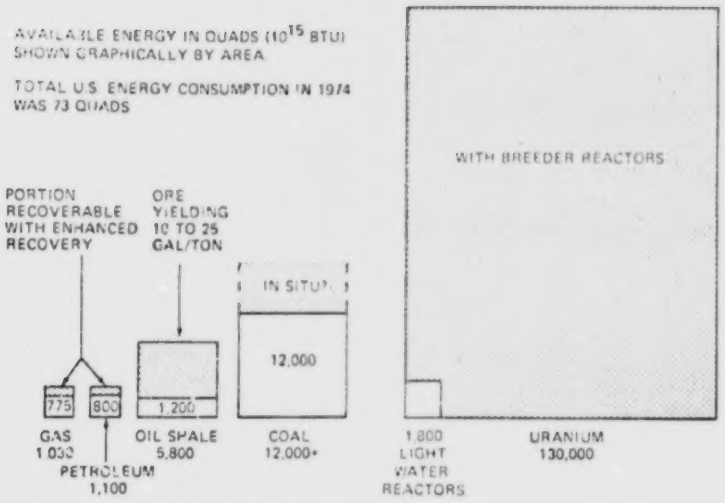
Slide 2.3


100 X 10⁹ METRIC TONS
Qe = 1486 X 10⁹ METRIC TONS (AVERITT ESTIMATE)
Qe = 1140 X 10⁹ METRIC TONS (MAPPED)
Production Rate (10⁹ metric tons/yr)
Years

Slide 2.4

Let's go to the third of that series now (Slide 2.5) and look at coal and oil and gas in relationship to the energy potentially available from heavy elements, from fissionable elements. One sees not only the attractiveness of even the light-water reactors as a significant national energy resource, but if you actually could get to a successful breeder system a great deal of additional energy would be available as potential future energy.

In the wake of 1973 several major new federal actions have occurred. The system is still in a high state of perturbation, and I guess that is an understatement of the year. Robert Louis Stevenson once said, "The obscurest epoch of them all is today." I guess that is our problem, too; it is hard to see where we are because we are so much in the midst of things. But there are several things that have happened.

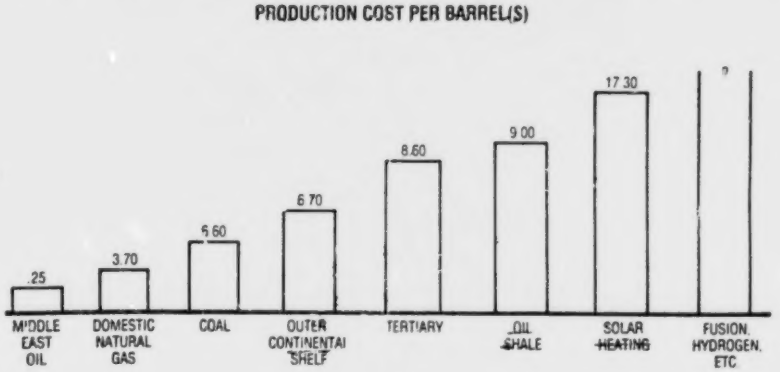


Slide 2.5

One is an energy review organization on the federal level. The AEC turned into ERDA and the Nuclear Regulatory Commission. Energy policy and current action programs expanded from the Federal Power Commission and the Department of the Interior to become the Federal Energy Administration.

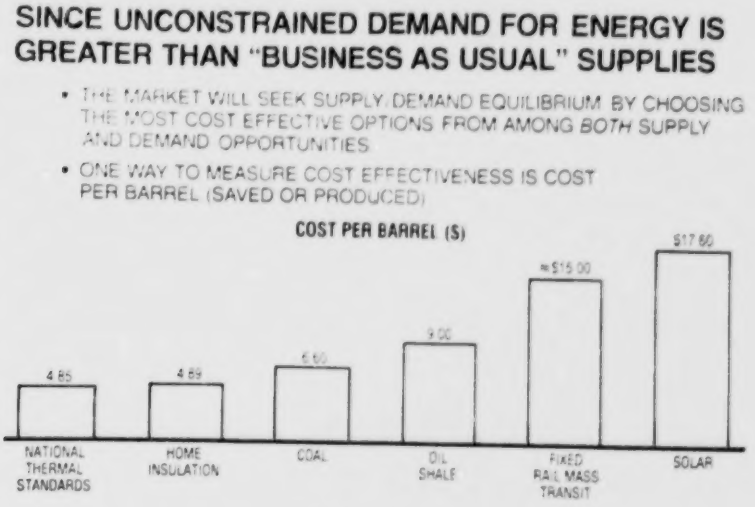
The next curve (Slide 2.6) is meant to indicate some of the strategies. As we looked to supplies of energy, we had been working on the far left side. (Production is given here in dollars per barrel equivalent of energy from various sources.) We knew that energy price was on the increase. We knew that going to the outer continental shelf would probably bring us more oil but at a considerably higher price, and the same for tertiary and perhaps oil shale if we can figure out how to do it. We knew that solar heating is another way to capture energy, but it involves a considerably higher price; and we knew that fusion might work, although no one yet quite knows how to make it happen.

RISING COSTS OF ALL ENERGY SOURCES POSE A THREAT TO THE CONTINUED ECONOMIC WELFARE OF THIS AND SUCCEEDING GENERATIONS.



Slide 2.6

Then, there was an expanded view of what our energy options might be (Slide 2.7). This slide indicates that you can not only have oil and shale and solar, but you can go back and talk about the equivalent barrel-of-oil price of insulating our homes or adding more efficiency to our transportation fleet. Therefore, the concept emerged of investment decisions made by balancing an increase in efficiency on the demand side against an increase in supply of quantities on the supply side.

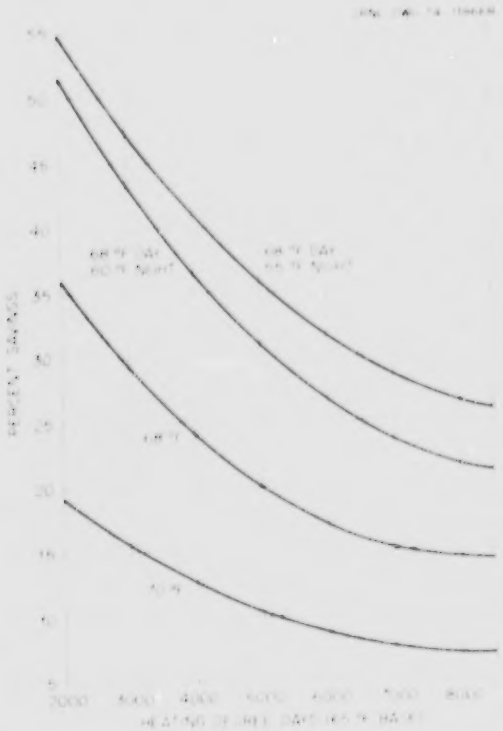

SINCE UNCONSTRAINED DEMAND FOR ENERGY IS GREATER THAN "BUSINESS AS USUAL" SUPPLIES
• THE MARKET WILL SEEK SUPPLY/DEMAND EQUILIBRIUM BY CHOOSING THE MOST COST EFFECTIVE OPTIONS FROM AMONG BOTH SUPPLY AND DEMAND OPPORTUNITIES
• ONE WAY TO MEASURE COST EFFECTIVENESS IS COST PER BARREL (SAVED OR PRODUCED)
COST PER BARREL ($)
4.85
4.89
5.50
9.00
≈$15.00
$17.60
NATIONAL THERMAL STANDARDS
HOME INSULATION
COAL
OIL SHALE
FIXED RAIL MASS TRANSIT
SOLAR

Slide 2.7

From these concepts and from the new agencies there emerged a federal energy management program, which is an agency. All the federal agencies are involved in undertaking long-term energy management programs within their own operations, to set the tone and sign of the times for the rest of the nation. These energy management programs are largely modeled after the very successful operations that major industries, particularly the energy-intensive industries, have been undergoing since the middle 1960s. Energy savings within the federal government agencies this year will amount to nearly 30% of the energy that would otherwise have been consumed. Those savings are being obtained by increased efficiency of operation rather than curtailment of operations.

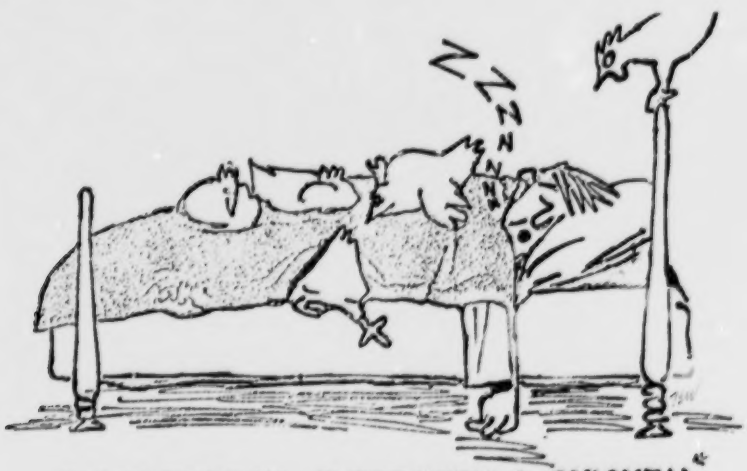
The second major step since 1973 was the passage of Public Law 94-163, the Energy Policy and Conservation Act. This act heavily involves the federal government in partnership with the states, which seems to me an eminently sensible idea, in a series of activities aimed at getting our energy utilization efficiency up a little bit, and as quickly as possible.

The next slide (Slide 2.8) indicates one of the first and obvious steps that you can do. This is a curve, courtesy of ORNL, that has had major national impact. It simply shows what can happen to the heating bill of the typical home as a result of the simple expedient of setting the thermostat back in the winter from 72° to either 70° or 68°. It also shows what can happen at night from 10:00 PM to 6:00 AM through the use of the highly complicated device known as a clock thermostat. Highly complicated is meant to be a joke. It is the simplest kind of technology, yet it can produce a reduction in fuel requirements for heating a home of as much as 40% in this region of the country.



Slide 2.8

The next slide (Slide 2.9) is one proposition that has been made by several people. It turns out that chickens have a body temperature of 107°. You can go wild with this slide, because if you have a catch basin on the floor and a little fermenter to make methane from the droppings you can even drive to work with the help of the chickens. There is even an Englishman who does it, I believe.



Slide 2.9

The next slide (Slide 2.10) indicates some other techniques, thanks to Eric Hirst's model. If you apply a little bit of engineering design ingenuity to structures, with essentially no change in the net building cost, you can reduce the energy required to operate that structure by a great deal. Depending on the price of energy, it is cost-effective to reduce the energy-intensiveness of those structures by well over 50%. This is happening. Obviously it will take quite a number of years to see these more efficient capital stocks replace and supplant our existing capital stocks, and that is one of the first lessons to be learned on the energy demand side. Time is required for the turnover of these stocks -- time very much equivalent to the kind of time it takes to change our energy supply systems significantly.

Energy Intensity[a] for Each New Building Type in 2010

(1975 = 1.0)

	Scenario			
Building Types	I	II	III	IV
Single-family	1.1[illegible]	1.0[illegible]	.7[illegible]	.51
Multi-family	1.10	.9[illegible]	.71	.52
Mobile Home	1.1[illegible]	1.0[illegible]	.72	.50
Commercial	1.1*	1.0	.59	.49
Educational	1.1[illegible]	1.0	.61	.52
Government	1.10	1.0	.61	.51

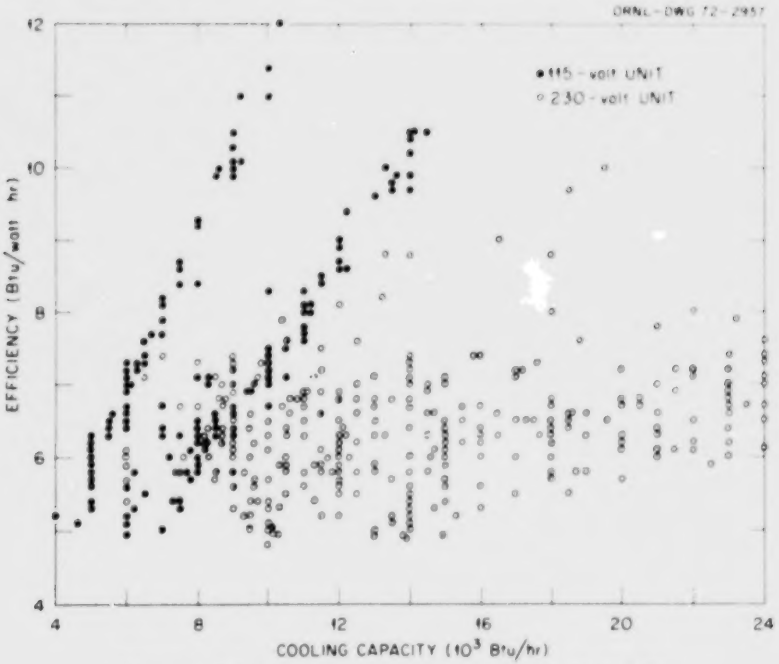
[a]Btu/unit for residential dwellings and Btu/ft² for [illegible]-residential buildings

Slide 2.10

The next slide (Slide 2.11), thanks to John Moyers at ORNL, is a plot of commercially available air conditioners. Capacity is shown on the abscissa and efficiency is shown on the ordinate. You can buy these air conditioners in the marketplace. Note, therefore, that in the marketplace one can buy air conditioners whose efficiency ranges over at least a factor of three. Information to the buyer on which of those air conditioners gets him his best buy is simply not there. The only information available to the buyer right now is, in fact, the purchase price, which has little to do with the actual total cost of operation.

So we find that, in general, as you look from one appliance to another, or from one kind of structure to another, there are remarkably large savings achievable in terms of the energy required to operate these things -- a very large savings compared to the incremental cost of producing the more efficient device. There are lots of opportunities, therefore, for substituting ingenuity and sophistication of design for brute force energy consumption.

The next chart (Slide 2.12) says that of the quarter of our total national energy budget that goes into transportation, well over half goes into the automobile. There is little wonder then that in the Energy Policy and Conservation Act (EPCA) there is a program to establish much higher fleet efficiencies for our passenger automobiles. The target would move the new car efficiency, that is, the sales-weighted average new car efficiency, up from about 15 miles per gallon as of a couple of years ago to about 27½ miles per gallon by 1985.

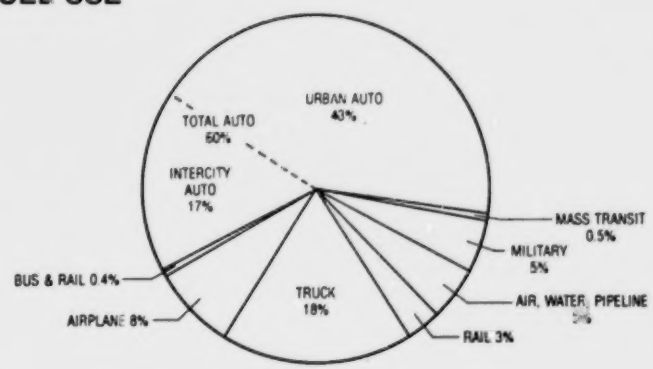


Efficiency of Room Air Conditioners as a Function of Unit Size.

Slide 2.11

TRANSPORTATION

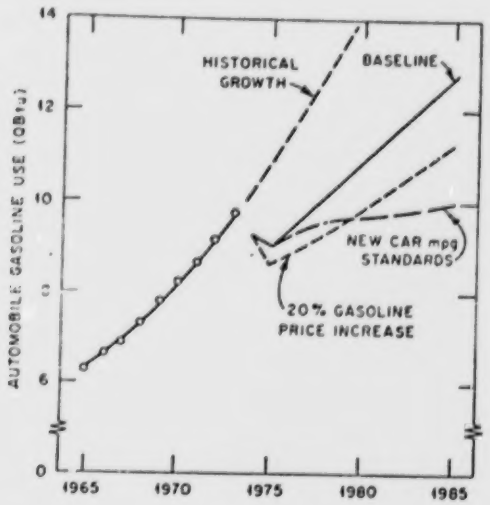
THE URBAN AUTO DOMINATES TRANSPORTATION FUEL USE



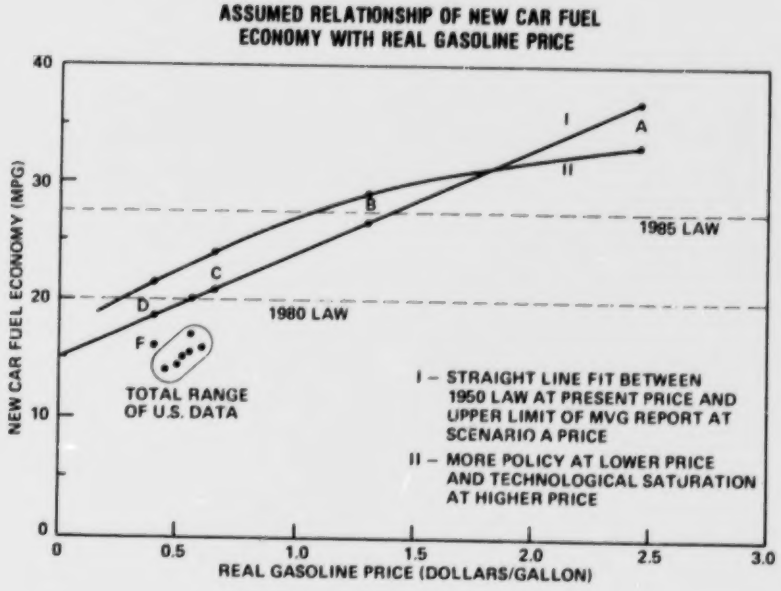
Slide 2.12

The next chart (Slide 2.13) shows what this might do to the demand for gasoline over that period. With the new car standards, one finds almost a flattening of the demand for gasoline over this period of time, and perhaps considerably beyond that into the future. Now, what does it take to get there? We are talking about almost doubling the average efficiency of automobiles.

The next chart (Slide 2.14) is a little indistinct, but I will try to show you part of the problem. You see, the ordinate here is the new car fuel economy in miles per gallon. The abscissa is the real gasoline price in dollars per gallon. The oval circle on the lower left is the total range of United States history. We have been operating for many years under 20 miles per gallon, and under 50¢ per gallon for gasoline. The



Slide 2.13



Slide 2.14

requirements of the EPCA act are to carry us up to the dotted line for 1985, to a new car average efficiency of 27½ miles per gallon. That corresponds to a shadow price of about $1.40 per gallon in real life. That, of course, is considerably less than the price of gasoline today in Europe, but still we are working in an area that we really haven't had much experience in before. Fortunately, Europe has, we can learn a lot from them.

Present estimates are that with some engineering ingenuity about 10%, perhaps less, additional front-end cost of the automobile will provide the present number of safe seats and present interior volume with this increased efficiency. There is a great deal to be gained through the redesign and changeover of automobiles.

You can't do it tomorrow. The turnover of fleet automobiles will take at least 15 years, so we should count on 15 to 20 years to see these things happen. But a great deal can be done that is cost-effective. So much for the Energy Policy and Conservation Act. It was passed in December 1975 by Congress, and has many, many strong implications for us in the years ahead.

A similar piece of federal activity is embodied in the Energy Conservation and Production Act (Public Law 94-385) which was passed last August. The elements of that act include the development and promulgation to the states, and through the states to the localities, of some energy performance standards for new building and electric utility rate design activity across the country. I guess Ed Berlin will speak later about a weatherization program for existing structures in the United States which is included in the act. There are also some major loan guarantees for industrial loans to increase the efficiency of industrial operations, and there are additional partnership responsibilities between the federal government and the states.

Right on the heels of that, Congressman Thornton mentioned last night a thing that he is rightly proud to be the father of, and that is the concept of the Energy Extension Service. Good information will be developed, synthesized, and transformed in this service to match the needs of the many constituents for energy-related information. The service will use the existing delivery systems to get this information out to people so that they can make decisions on the basis of good information rather than myths.

What comes next then? Well, it seems to me in our emerging national activities we will refine the reorganization of energy in the federal government one more time. Presumably this reorganization will be a synthesis of existing agencies; the message on that will come within a couple of weeks. I won't try to predict what it will contain specifically in terms of organization, but I will try to predict what it will contain in terms of emphasis.

We will emphasize the substitution of ingenuity and innovation for brute force energy consumption. Second, price will shift towards its real total cost, through the further removal of subsidies and allowed externalities, and perhaps even the addition of some surcharges on imported oil. We will find a focus on increased efficiency of energy utilization, because it will help our consumption system match the new price of energy and it will ease the rate at which we have to produce new supplies. There will be a better balance struck, I believe, between attention to nuclear and nonnuclear energy sources, and between electricity and liquid fuels.

A major effort will be required to quickly raise efficiency of consumption. That effort is difficult enough in itself, but it is relatively easy compared with some of the problems we face on the supply side, particularly the production of sufficient liquid fuels in 1990 and succeeding years. I think the bottom line of all these new policies will be an activity that is one of the best examples of a democratic society: mutual coercion. We know the things we need to be doing as individuals, and we are not inclined to do them unless everyone else does; we will find mutual coercion through regulatory processes operating.

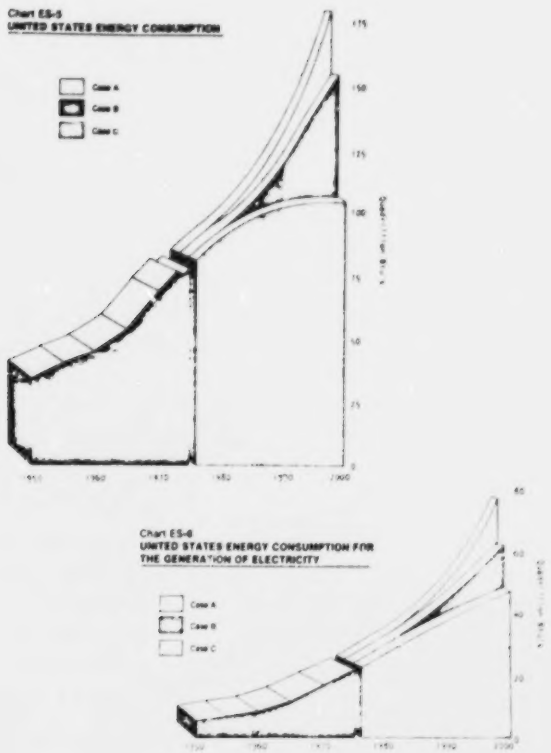
Let me conclude by saying that we have seen an exponential growth of power generation for some time, a remarkable straight line on a semilog graph, both for the United States and for the world (Slide

2.15). When you begin to disaggregate and look at the details of this exponential growth, you find that it has been driven by a rapidly expanding population, by rapidly expanding disposable personal income, and by rapidly falling energy price relative to other goods and services. At least two of these three things are now very different. Our population growth rate is slowing down, our energy price is going up, and the rate of expansion of disposable income is slowing down. Therefore these rates will tend to fall off naturally; that is, we are not talking about decreased consumption, but decreased rates of expansion of that consumption. The issue is, how fast will they fall off; how fast will they need to fall off for us to be able to keep up with them, and where might we go too far in trying to slow things down?

Slide 2.15

In trying to anticipate plausible futures, there are several federal activities under way, as well as several private ventures. One is called the Committee on Nuclear Energy and Alternative Systems, which is a study under the National Academy of Engineering, sponsored by ERDA. A report on this study will be completed by July 1, giving a look from now to the year 2010. The year 2010 is rather an arbitrary time, but by then the breeder reactor and other advanced technologies could become significant.

Another study (Slide 2.16) is by the National Petroleum Council; it is a cooperative effort between federal government and industry. In the slide one sees plausible futures explored in terms of the tracks or trajectories that energy consumption may take over the next 25 years. We are not only exploring a continuation of some exponentials but, as shown by a move of the negative second derivative over towards some kind of equilibrium, a transition is now being explored. Perhaps we are already in the middle of this transition—hopefully we are—between an exponentiation and an equilibrium point.

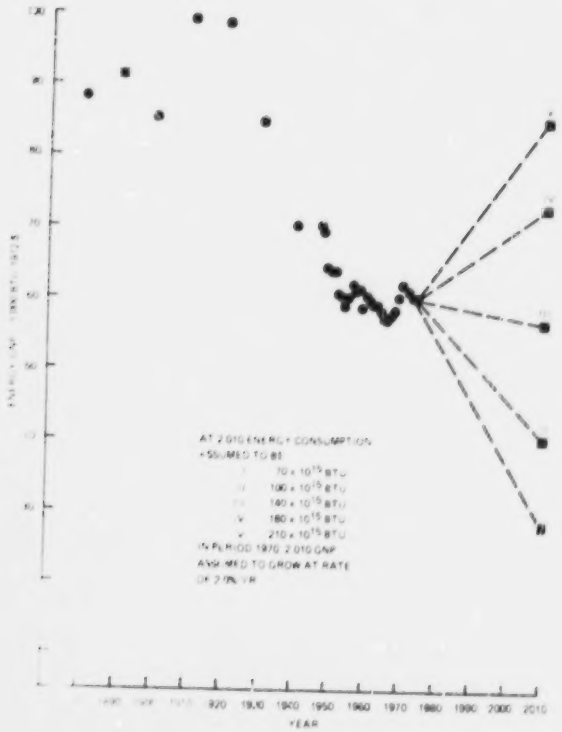


Slide 2.16

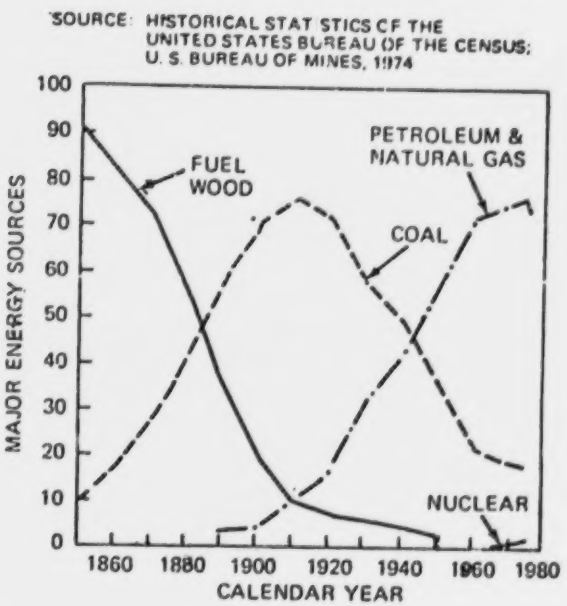
The next curve (Slide 2.17) reminds us of a debate that will probably continue forever: the question of the relationship between the production of goods and services and energy consumption. How closely are they related? The relationship is explored here by looking at the ratio of energy to production; one sees that it does, in fact, change quite considerably over time. You can make it look like a close correlation if you just take out the middle block from 1950 to 1970, and then expand it horizontally and plot it on semilog paper. At the same time, if you look at it over time you can see that this ratio changes considerably.

The issue is, where does it go from here? In the near term, energy and production are very tightly coupled because we are dealing with a system that has inherent energy efficiencies built into it. In the long term, however, in the time frame that it takes to turn over the capital stock of energy-utilizing equipment, that ratio can change quite significantly. So the answer is, in the near term, energy and gross national product are closely tied. If you try to shift one the other will shift with it, though in the long term they are very elastic.

The final slide (Slide 2.18) returns us to where Pat started this morning. Besides the transition in demand growth from exponentiation to equilibrium, we are hopefully in a transition to a new condition—a condition in which some other new kind of energy source will replace oil and gas. Coal, obviously, is going to help us in that transition.



Slide 2.17



Slide 2.18

We are not sure where we are going to end up. But we also know that we don't have that much time — perhaps half a century, or for the optimist perhaps one century. That is honestly not very much time at all.

So I think we find federal efforts moving now from a period of subsidy to a period of removal of subsidies, recognition of external prices, and incorporation of those costs into the price system. Finally, there is a move to the development of new options of energy supplies to get us through this transition, a policy of decreasing our growing dependence on foreign sources, and a policy of increasing the efficiency of energy utilization throughout our entire system. I don't think we ought to ask for much more in this short period of time. I think we will get considerably more, however, over the next eight years. I will remind you of Neal Morse's comment about the future, however. He said, "It's very difficult to make accurate predictions, especially about the future." Thank you.

3. LOCAL GOVERNMENT'S ROLE IN DETERMINING ENERGY SUPPLY AND DEMAND POLICIES

Edward Berlin

Chairman Tom Waldrop: Our next speaker today is Mr. Edward Berlin. Ed is a lawyer with degrees from Columbia and City College of New York. He has had extensive experience in public interest law, with emphasis on environmental, consumer, and employment discrimination litigation. He has worked for the Department of Justice, the Federal Power Commission, and is a partner in his own firm.

Ed has done consulting in major research for the Environmental Protection Agency, the Department of the Treasury, National Product Safety Commission, Office of Economic Opportunity, and the Ford Foundation Energy Policy Project. Much of this work has been related to electricity pricing. His advisory activities include membership on the board of advisors of the *Environmental Law Quarterly*, the editorial board of *Energy Systems and Policy Journal*, and the Advisory Committee on State Regulations. His scholastic and professional honors include Harlan Fiske Stone Scholar, Justice Department Meritorious Achievement Award, and the Federal Power Commission's Distinguished Service Award. He is the author of many publications and is in great demand as a speaker.

His present assignment is Commissioner of Public Service for the State of New York, and appropriately his subject is local government's role in determining energy supply and demand policies.

Mr. Edward Berlin: Thank you. I actually thought when Tom wrote me that I would be speaking primarily to a group of legislators. I was delighted last night to find out that it was to a group of engineers. I was delighted for two reasons. For one thing, I can now elevate the level of my discourse. But more importantly, I firmly believe that it is very important for people like myself who are concerned with regulations, who want regulations to work effectively and responsively, to speak with engineers to try to entice engineers into playing a more active role in the regulatory process. It was largely for that reason, at the invitation of Bob Marshall of the University of Wisconsin, that I went to the College of Engineering for a year before I went with the New York Public Service Commission. I would like to say a few things about that toward the end of my remarks.

I have been asked to speak on the subject of local government's role in energy policy, and particularly in supply and demand policy formulation. I assume therefore that I have been asked to address the question of whether or not a local government should have a role in the formulation of supply and demand policy. Being a bureaucrat now, and having the facility to answer in the best of bureaucratic traditions, I am able to respond yes and no. I really don't mean that in a sense of ambivalence — I really mean yes and no. I firmly believe that government has a very deep responsibility to be involved — indeed, to be the guiding force — in energy policy formulation on the supply and demand side, but I also believe that it cannot be local government. I believe that if we are going to have an intelligent energy policy, we must have a regulatory mechanism that is legally and technically competent to deal with energy in its most rational sense. That means multiagency, multienergy activities, and it certainly means at least statewide involvement, if not, ideally, regional involvement.

Before I get to the specifics of what I think regulations in particular should be doing these days, I think in fairness to you I should indicate my sense of personal bias, so that you can evaluate for yourselves whether or not you should attach any significance to the specifics that I would like to offer for your consideration.

I do believe that it is the government's responsibility to determine energy policy as I have indicated, and I believe that for a not very profound reason. As I hope we can all agree, energy policy intimately affects public policy in both its broadest sense and in each of its narrowest applications. I could, I suspect, spend the balance of my time pointing out to you ways in which I believe that to be true; I am not sure that that is necessary. I am sure you agree that one cannot simply adopt notions of energy growth without considering preservation of environmental health and environmental quality. One cannot simply recognize any relationship, at least historically, between gross national product (GNP) and energy growth and adopt energy policies that are oblivious to the effects that those policies might have on inflation and recession. It does little good to stimulate economic vitality if that economic vitality is ravaged, as it has been over the last two years, by the greed of recession and by the greed and disease of inflation. So, we have to get involved in balances and in competing social tradeoffs. And that, in my judgment, is the essential responsibility of government.

Government has the delegated responsibility that we as a nation give to it, on all of its levels whether it be the county clerk or federal decision makers, to balance competing social tradeoffs and to strike the proper balance in furtherance of the overall public interest. Yet it is a responsibility that has largely been left by default to the energy suppliers, and we really should not be shocked with the result. Ours is an incentive society; that, in my judgment, is where our strength lies. We should want our industrial firms to be honest profit maximizers, for in my judgment those types of incentives and that type of competitiveness will yield the greatest sense of progress in the best sense of that term.

I believe very strongly in consumer sovereignty determining the best public good. And if we have the right types of incentives and competitiveness, we will achieve the most efficient progress through the operation of true consumer sovereignty. If, as a result, oil profits appear to be obscenely large while the rest of society is being torn apart by inflation, I suggest to you the fault may not lie with the oil company or with the electric utility or with the gas distribution company. Rather it may lie with the structure of the decision-making process that we have permitted to develop—whether it be an imperfect market that is too easily captured by an oligopoly, or moribund regulation that fails to recognize what should be its singular objective. This is how I approach regulation.

My attitude toward regulation is a very precise one: I do not believe in regulation for the sake of regulation or for the sake of having a job for myself and my associates. I believe in regulation because it is necessary to introduce into monopolistic market structures the kinds of incentives and pressures that would apply if we had a competitive situation. In my judgment, the single most important function of regulation is to emulate as nearly as possible the pressures, the pulls, the strains, and the stresses that would operate in a free, competitive society.

Unfortunately, until very recently regulation has largely been moribund. It has been content to concentrate on the larger issues; it has ignored the so-called smaller issues. The larger issue that it has concentrated on, for example, on the electric side has been the total revenue requirement to which the utility will be permitted to set its rates, or seek to achieve. It has failed to recognize, however, that supply and demand decisions made by the firms and the utilities intimately affect those total revenue requirements. This is true not just for electric utilities only, but for gas utilities as well. Gas utilities build liquified natural gas (LNG) facilities that cost, as they do in New York State, $7 per thousand cubic feet (Mcf), or synthetic gas facilities that cost $6/Mcf, those are supply decisions that intimately affect total revenue requirements. When utilities sell that $7 gas that came in priced at $2/Mcf, disregarding price

elasticity effects, those are demand decisions that intimately affect the future cost of capital expansion, capital expenditures, and total revenue requirements. Those are issues that regulation, if it is to be worthy of being called regulation, simply must address, and must address aggressively, not for the sake of regulation, but because in a competitive structure, competitive forces would be addressing those issues.

So, let me discuss with you in a fairly sketchy form the kinds of things that I see regulation doing today, that I see that it will have to do with increased vigor tomorrow, and areas where I think engineers can and must and should play an absolutely vital role.

I think you all know that with regard to the two energy areas I am most concerned with, electricity and gas, the price pressures on the electric side have been caused by the enormous rise in capital costs, in fuel costs. On the gas side, we have been experiencing diminishing supplies at greatly accelerated incremental costs. We have got to begin developing regulatory policies that are cognizant of those realities, not the realities of the 1960s that Jack spoke about, or the 1950s, but the realities of the 1970s and those that are sure to come in the 1980s and 1990s.

On the demand side—and it has spillover effects on the supply side—regulators simply must get involved in the planning process. They must get involved at the earliest possible time, and I mean this for both electricity and gas. In New York State, if you will forgive just a bit of parochialism, we do try to get involved at least on the electric side fairly aggressively. Each year our utilities are required to file with the New York Power Pool, which is an integrated power pool, a ten-year planning document that specifies the demand projections and their supply projections. We have very detailed but abbreviated hearings on those projections. We do this because we believe very firmly that the public has a right to participate in that kind of planning, decision-making process. We believe that this public participation cannot effectively take place at the time when a utility files an application for a particular site authorization. All of the frustrations that we have experienced for the last several years over delay in site certification come about, in my judgment, because that is the wrong point in time to get the public actively involved.

As engineers, you know the die has long been cast by the time an application is filed with our commission, with the NRC, or with any other commission, for site selection for a nuclear plant, coal facility, synthetic natural gas (SNG) facility, or coal gasification plant. You wouldn't be filing that application if you didn't have options for a reactor, if you hadn't invested millions and millions of dollars in site selection activities, equipment selection activities, and design specifications and if you hadn't developed a timetable which allowed 18 months for regulatory certifications and $5^1/_2$ or $7^1/_2$ years for construction.

You have effectively frozen the public out. I can understand when you come in and say, "Intervenors are holding us up." But picture yourself in the position of the intervenor who is told, "We really can't change those plans because we have paid Westinghouse $2 million already, and it doesn't serve the consumers of the state well to forfeit that payment." And indeed it doesn't. Consider what you do to regulators when you say that. We are terribly frustrated by it.

So, we believe (1) that you have to get the public involved early; (2) that there are responsible members of the public who recognize the relationship between GNP and energy production and supply; and (3) if given an opportunity to be significantly involved in the planning process, these individuals will respond intelligently and meaningfully. I urge those of you who do not have planning procedures that precede application for site certification or for facility certification to consider developing them. I think you will be surprised that there are responsible people out there who want to participate and not obstruct. You must, as part of that, give the public an opportunity to examine the demand projections. The public is cynical about demand projections supplied by utilities, and in many cases rightly so, because utilities until very recently have ignored price elasticity effects.

We demand that our utilities put in sophisticated demand projections on a ten-year basis, using not only judgment, but also fairly sophisticated modeling techniques and econometric techniques. I will be the first to concede, since I am not an economist, that you can do as many tricks with that as you can with Jack's semilog paper, but it's a tool – it's one tool that must utilized. We must also have a capability for independently determining what our true oil and gas reserves are and an independent capability to determine what our demand projections are likely to be. If we are not able to do these projections ourselves as a public agency, then we must at least have the sophistication to ask the right questions to make certain that the utilities properly carry out demand projections yearly, utilizing proper methodologies.

Part of that is a question that engineers have got to face up to: the question of reserve modules. This is a very critical question in the case of electricity, as I found out about a month and a half ago, and not a totally irrelevant question in the case of natural gas.

We have been striving for a fairly high level of reliability in New York State. Our utilities plan for a one-day loss of load probability in ten years. That is actually not a disconnect of one day in ten years because it presumes voltage reductions and customer appeals; it's something closer to one day in a hundred years if you look at actual disconnects of any duration at all. Years ago when capacity was coming on-line at $200 kilowatt, when we were enjoying the benefits of dynamic technology and economies of scale, it may have been appropriate to be oblivious to the level of reliability we were planning for, building for, constructing for, and paying for. I suggest that is no longer the case. It is a terribly relevant question to ask whether the reliability that we are building into our systems is cost-justified and whether the benefits exceed the costs.

In New York State we now have a nuclear plant coming on-line at upwards of a thousand dollars a kilowatt. We cannot afford to have more capacity than is cost-justified. Now, this may be a terrible time to talk about reliability in light of the recent natural gas crisis, but maybe it's an ideal time; maybe that is an apt example.

I was called before every legislative committee in the state and several new ones that developed over the natural gas crisis, and I was asked repeatedly by legislators and by every newsperson who interviewed me on a daily basis, "Couldn't you have foreseen it, and couldn't you have prevented it, and what are you going to do in the future to make sure it doesn't happen again?" The answer is, we couldn't have foreseen it; I won't bore you with the details of why. More importantly, even if we had we would not plan for it. We would not plan for it because it would make lousy economic sense to do so. You don't go and build storage facilities to plan against an occurrence that everyone tells us now is not likely to occur once in more than a hundred years. It doesn't make economic sense. It doesn't make sense from the consumer standpoint or from our GNP standpoint. You withstand those temporary discomforts, as painful as they are, in New York State and elsewhere because it makes economic sense to stand them. The same thing is true on the electric side. We must ask whether we are building overly reliable systems, recognizing the cost consequences of those decisions.

Let me turn to a corollary question now—the question of joint planning. In New York State we have a power pool. Most of the country has a power pool, but most of the country is not as fortunate as we are because our power pool is confined to New York State, and that gives us the ability to deal with it in a regulatory sense. That is why I believe that in most portions of the country it is necessary to move regulations to a regional level. It is absolutely essential that we further power pools and that power pools practice economy dispatch.

We are now moving to economy dispatch in New York State, finally, centuries after we should have. Very shortly the New York power pool will have a computer-based operation. This framework will allow it to call into action its most efficient unit anywhere in the state or anywhere outside the state where

it has the ability to make wholesale purchases as demand in the state grows. We simply must make certain we have that capability in other states, in other regions, and perhaps even on a national basis in order to take advantage of seasonal and time-of-day diversities.

You should keep in mind that the fuel adjustment charge has an impact there. Those of you who are concerned with economy dispatch and think it makes sense to practice and further an inter-utility arrangement should take a look at the fuel adjustment charges that are operating in particular states. There could well be disincentives to those types of transactions. If you have a fuel adjustment charge, it is essential that that charge have within it the ability to pass through economic purchases made on a wholesale basis; otherwise you will be constructing disincentives. Utilities are profit maximizers, at least in between rate cases. They make rational economic decisions, and you should make certain that the fuel adjustment charge does not contain a disincentive to rational planning.

We have just discovered this disincentive in our own fuel adjustment charge. We thought that we were very smart; we allowed for flow through economy purchases and wholesale purchases in order to encourage economy dispatch. Well, we had two recent nuclear outages in New York State, one in New York City and the other in Rochester. The one in New York City was a scheduled outage; it took the plant down in March for what was supposed to be a two-month scheduled maintenance operation. But lo and behold, it was out for six months, throughout the entire summer period — the peak period in New York State and certainly in New York City. We found that in Rochester a plant went out as an unscheduled outage; it was an even more serious situation but the plant got back on-line within a month. We were perplexed and took a look at the situation.

It turned out that the utility in New York City was making economy purchases throughout all this period of time, because it had very inefficient generation on its own system and our fuel adjustment charge allowed it to pass through all of those economy purchases. They didn't have very much incentive to get that plant back on-line, and it cost the consumers in New York State, according to our staff's estimate, $64 million.

The utility in Rochester was not making economy purchases. It was making dis-economy purchases; it was eating it. The loss was coming out of stockholder bucks, out of net earnings. I am told that the president of the company was down there at the plant site supervising putting that plant back on-line. My point is, again, that utilities are profit maximizers; we have got to make certain that we give them the proper incentives.

Let me talk about load factors for a moment. As you all know, we are experiencing terrible deterioration of load factors. It is certainly a problem in the Northeast; I assume it is the same in the Southeast. We have utilities that are operating at less than 50% load factors. I think statewide we are at about 55%, and we simply cannot tolerate that from a standpoint of resource conservation and economic conservation. We have got to develop regulatory policies that induce load factor levels. Regulation is beginning to look at techniques for leveling load, not just marginal cost pricing, which is nevertheless essential. Engineers can play an essential role here.

Engineers never have any difficulty understanding the logic in marginal cost pricing; it's only regulators who do, because engineers plan system expansions by using techniques of marginal cost pricing. We have got to start thinking about interruptible rates. We directed all of the utilities in New York State several months ago to come in with interruptible rates for large industrial customers and to come in with new rate filings. We have got to think about inventive and not-so-inventive mandatory load control mechanisms, time devices on furnaces, radio control of space and water conditioning loads, and storage systems. We have got to think about voluntary load control techniques, such as marginal cost pricing and time-of-day rates, in the case of electricity. We simply have got to give industrial users, in particular, the incentive to cost-minimize for themselves and to cost-minimize for our utility systems.

Remember, I believe that we have to give utilities incentives, and that leads me to conclude that perhaps we should be thinking about putting utilities in the conservation business. We do require them, on a mandatory basis in New York State, to have insulation programs and conservation educational programs. But that is not enough. I believe that we must get utilities involved in load control, load management, storage technology, and solar technologies, and we simply must give them an economic incentive to be involved. They are private companies; they are profit maximizers; that is what they should be. We should utilize the best of that system in the public interest, and I would like to see us give more and more attention to the development of incentives. That is where engineers again can play a tremendous role.

Regulators are now willing to respond with modifications to price structures that make sense. By "make sense" I mean that cost-minimize as far as total societal costs are concerned. If you can develop for your industrial clients opportunities that permit them to shift load, for example, without diminishing economic vitality or productivity, regulation will respond. If you can show us ways that you are cost-minimizing, we will develop rates that reflect those cost savings. Everyone, even those users who cannot participate in that particular technology, will then be better off, because if we can slow the growth of capital expansion, if we can slow down the need to turn over the 2 or 3 or 4% money that is now embedded in utility capitalization structures and is being turned over at 10% or, we will all be better off.

Lastly, I just want to make one comment in the hope that some people are here from the federal government, one observation about natural gas policy. For the last two years we have been trying to convince the federal government to develop at least one edition of a rational natural gas policy. Right now, if you reflect on it, the federal government's policy contains enormous disincentives to intelligent state management of natural gas supplies. There is a great fear among regulators, who must of necessity maintain a somewhat parochial view, that if they are aggressive in husbanding their natural gas supplies, their state will suffer the consequence should there be a repetition of the winter of 1976–1977. That is because the Federal Energy Administration has announced, and the Federal Power Commission has given indications, that it will be shifting SNG supplies, propane supplies, and pipeline supplies around to meet national needs.

We agree with that. I went with the governor of New York to testify in support of the President's legislation. We agree with it on an emergency basis, but we think it is poor national planning to say to New York State, "Because you had the foresight to cut off attachments of natural gas hookups in 1971 and because you built (at great cost to your consumers) SNG facilities which are now producing natural gas at $5.35 Mcf and LNG facilities which are costing $7 Mcf, you have enough gas to take care of your basic needs, and we will therefore take away the lower cost pipeline gas."

That made sense in the winter of 1976 and 1977, and it will make sense in any crisis situation in the future. But if you are trying to induce states like New York, Tennessee, or Washington to become actively involved in the exotic supplies of gas you must provide an incentive. We want to be involved in coal gasification in New York State. But we have responsibilities to the consumers of New York State, and we will lose interest in the idea if the federal government allows us to believe that if we build a coal gasification facility at hundreds and hundreds of millions of dollars we may be doing no more than replacing high-priced gas for low-priced gas that we will lose to other states that have sat back and not developed exotic supplies and have permitted the continuation of attachments up until this fall. Federal policy must establish a base year for national gas supplies for each state and must encourage each state to maximize the utilization of those supplies. The states must be given the assurance that if they go into exotics, if they promote conservation, and if they promote price structure changes to get elasticity effects, they will not suffer a loss of those supplies.

I am sorry I don't have any chance to stimulate all of you engineers to get involved in regulation; perhaps I have given you enough stimulus to stay away from it now. I have one final comment to make that frightens me: I am making technological decisions every day of the week, and I am not a technologist.

I know engineers are cynical about the regulatory process. You are cynical about it for a very good reason: it's an adversary process, and you don't very much trust adversary processes. You like to get around in forums like this and have nice, intelligent, sophisticated, and fairly calm discussions to work out your differences. But public policy formulation doesn't often get resolved that way; it gets resolved in the adversary pits. I suggest that you have a responsibility, not only to your profession but to the public in general, to enter the fray, notwithstanding its deficiencies. Perhaps when you do enter it, we will be able to work out some of those deficiencies, and the result will be a better regulatory decision-making process. Thank you.

Anonymous: I would like to make a comment. You mentioned defeat of a bond issue which essentially destroyed a program. I happen to live in San Diego County, within two miles of that new facility being built. I first found out about it by accidentally coming across a brochure on it from the Government Printing Office in Washington, D.C. If a better job is done to educate local citizenry about projects of this sort it would help general acceptance. There would be a better understanding of the need for these facilities, and maybe bond issues would be passed, rather than defeated.

4. MUNICIPAL SOLID WASTE MANAGEMENT ALTERNATIVES

C. Wade St. Clair

Chairman Tom Waldrop: Our next speaker today is Wade St. Clair, who is Vice President of Information for the National Center for Resource Recovery. This is a nonprofit research organization formed by a coalition of 12, now 17, industries and representatives of American labor, to assist in seeking solutions to national solid waste management problems.

The NCRR's primary efforts are towards spurring development of resource recovery systems and demonstrating the economic and technical feasibility of mechanically separating materials of value from mixed municipal refuse. In addition to preparing studies and surveys in the field of solid waste management in resource recovery, the center is conducting a recovery equipment test and evaluation program in the District of Columbia, is providing institutional assistance to a number of state and local governments, and is helping institute a major demonstration of a recovery resource facility being built in New Orleans. The National Center's information programs include a variety of multimedia services relating to how communities practice solid waste management and which resource recovery systems exist and which are emerging.

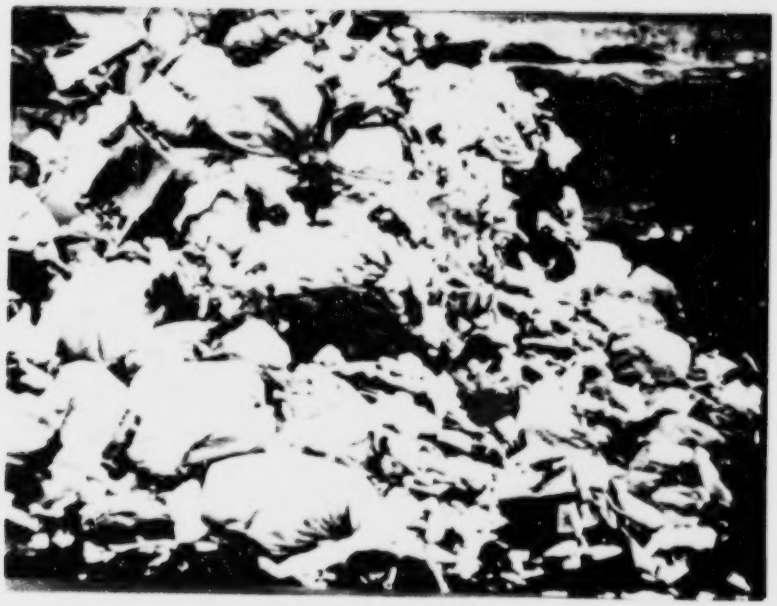
Wade St. Clair joined the National Center in May 1971 after having served as Director of Public Services in NASA's Office of Public Affairs. That office had the responsibility for publication, film distribution, exhibits, and public projects in astronaut activities. He had a tour of duty with the U.S. Air Force, then began his information career with Jefferson Standard Broadcasting Company in Charlotte, North Carolina, serving as Program Manager for WBT radio. He is a graduate of Duke University. His subject, very appropriate for Knoxville at this time, is "Municipal Solid Waste Management Alternatives."

Mr. C. Wade St. Clair: Thank you, Tom. Some of you are undoubtedly wondering why, at a session that is considering and analyzing the national issues of energy conservation, you have a speaker to talk on the subject of garbage. Until the last few years, trash and garbage were of interest only to those individuals, organizations, and agencies that had direct responsibility for its management. So it was not the topic at sessions like this. But I think the subject of energy was not considered a national issue until recently. Undoubtedly times and conditions have changed, particularly with energy and solid waste. Indeed, the very perception of the subject has changed. Everybody talks about trash and garbage now, but they call it by its new term, "solid waste," or as Jonathan Winters so aptly phrases it, "garbage."

There are some direct and indirect connections between energy and waste. I would like for the next few minutes to run through some slides from the "Wonderful World of Garbage" and to introduce the subject of resource recovery.

This (Slide 4.1) is my subject: municipal solid waste. From a national standpoint there are about 145 million tons that is generated annually in homes, businesses, and commercial establishments, and that enters a local system for collection and disposal.

Unless properly controlled, it produces an environmental degradation of land, air and water, and of course can pose a health problem (Slide 4.2).

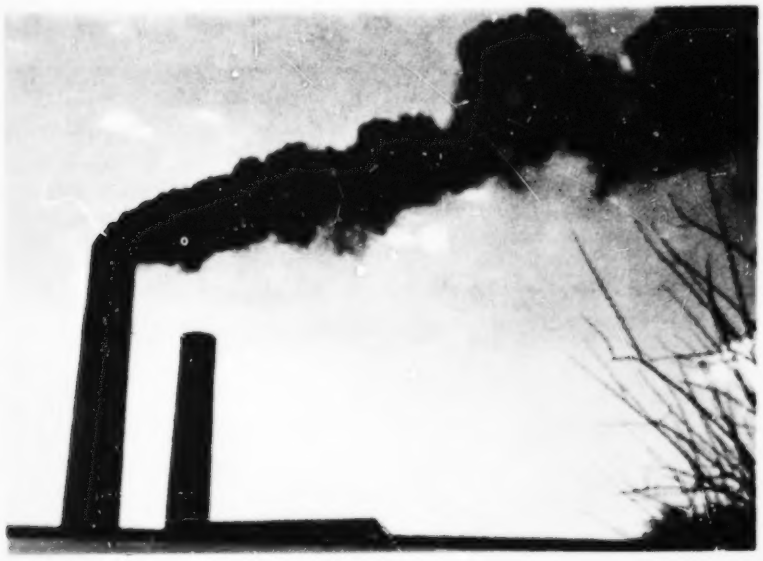


Slide 4.1

Slide 4.2

Improperly filtrated, municipal incinerators pollute air (Slide 4.3), and rigid air quality standards have closed a number of incinerators across the country.

What are the answers to it? There are all sorts of solutions. There are some people who believe that if we have 145 million tons of solid waste a year, somehow we can reduce the amount that gets into a municipal stream. At the opposite end of the scale there are those who say we have been living with our residuals since man began, why worry about it. In between there are a number of other approaches. This is one of them! (Slide 4.4) That has been a pretty common practice too -- put it off in somebody else's backyard and let them worry about it.

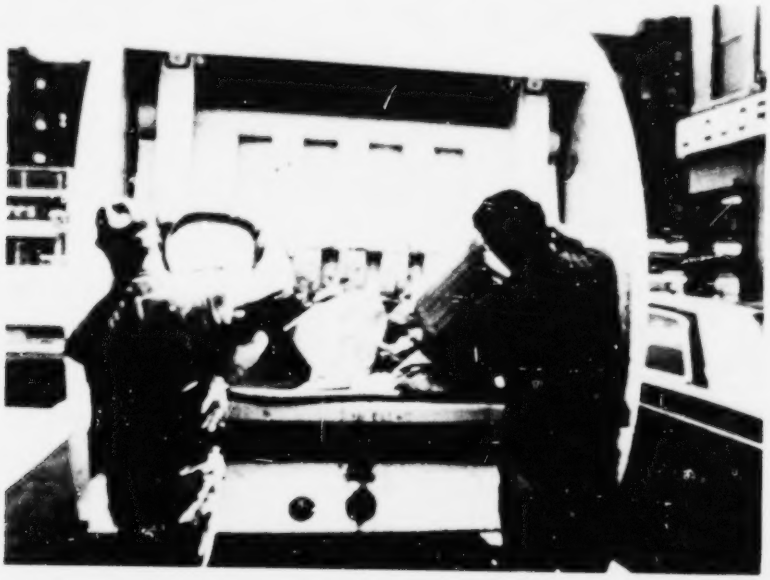


Slide 4.3

Slide 4.4

The municipal solid waste management system, regardless of whether it's in New York City or Gallatin, Tennessee, starts with the collection of the waste (Slide 4.5), and this is a pretty expensive part of the solid waste management system. About $2.5 billion is spent each year by jurisdictions just to pick the garbage up and take it somewhere.

About a half billion dollars goes to its disposal at the present day (Slide 4.6). New federal regulations through the new Resource Conservation and Recovery Act of 1976 will impact very directly on disposal. This act, signed into law last October, mandates that by 1983 the prevalent practice of open dumping will be no more. That is going to be a very difficult assignment for many communities to meet.



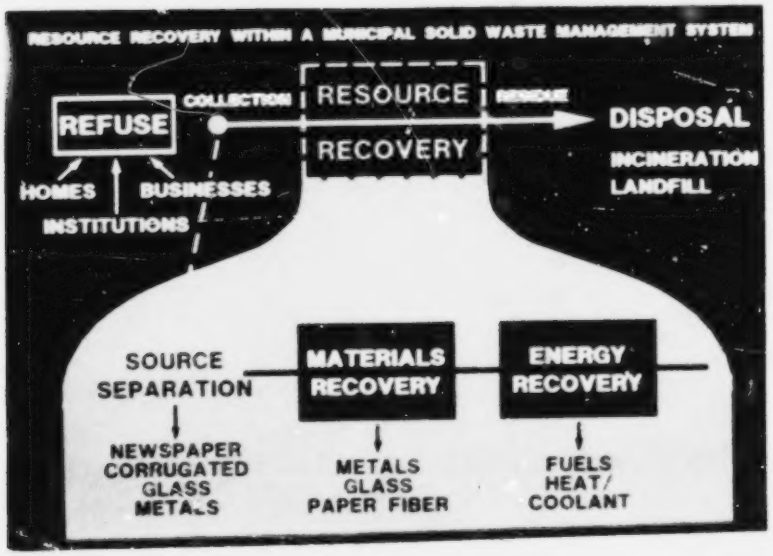
Slide 4.5

Slide 4.6

it is a question of how quickly a country that has widely used the open dumping practice can adapt to some form of sanitary landfill (Slide 4.7).

Economics and environment are impacting toward growing resource recovery systems. Resource recovery can be defined as the extraction and reuse of materials and energy from solid waste. It can take a number of forms (Slide 4.8), and it can come into play anywhere between the collection of the waste and its disposal. It can include both labor-intensive source separation programs and capital intensive materials and energy recovery systems. I know that here in Knoxville there is a present consideration for systems in the capital intensive area.

Slide 4.7



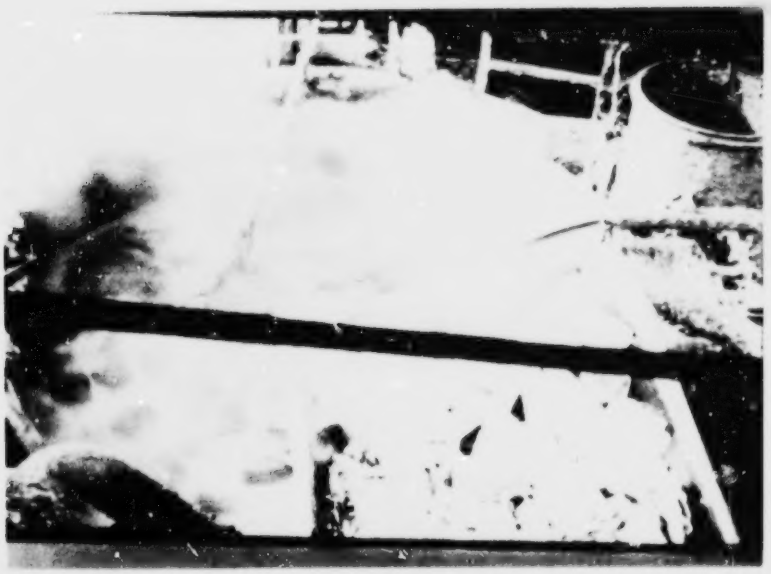
Slide 4.8

But what is recoverable? More specifically, what is in the waste stream or the municipal trash can? (Slide 4.9). It is a basic mingling of organics and inorganics. About 70 to 80% of it is combustible: plastics, paper, yard waste, and food waste and the like. Up to about 20% is metal and glass; the rest of the residuals are just dirt and gook and stuff that has no value.

This slide shows one type of source separation (Slide 4.10). There are about 120 municipalities around the country with newspaper collection programs. This is where the papers are bundled and set out for some type of regular collection. One of the uses of the paper is evidenced here (Slide 4.11). This is at the Garden State Paper Company in Garfield, New Jersey. This plant takes about 250,000 tons of

Slide 4.9

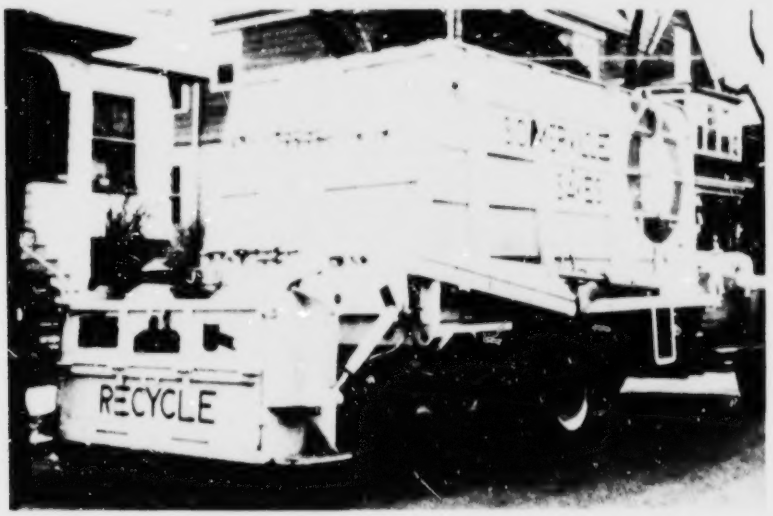
Slide 4.10



Slide 4.11

papers a year, de-inks them, and produces a recycled newsprint, which is competitive with the virgin newsprint. There are a multitude of community programs and voluntary programs for the collection of bottles and cans, as well as paper.

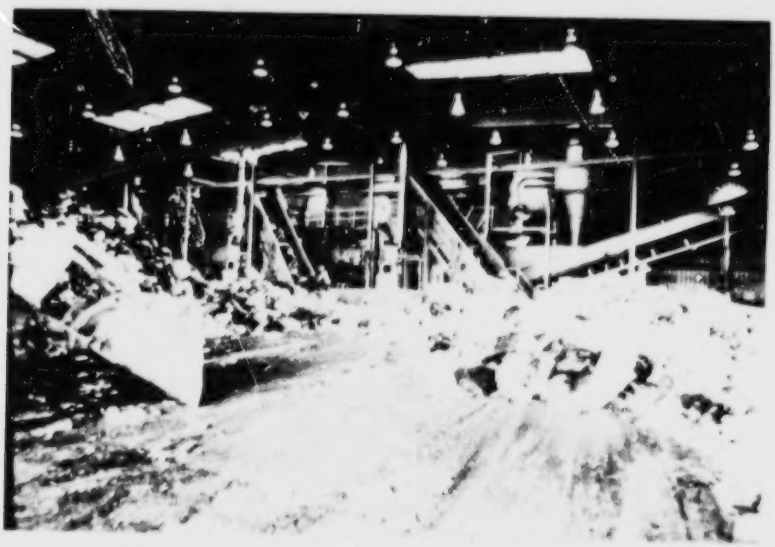
The EPA has a demonstration ongoing in two communities outside of Boston. This (Slide 4.12) is the one in Somerville, where bottles and cans go into one container, mixed papers into another, and regular refuse into a third. Special trucks pick the material up; metals and glass are separated, and the papers are separated and sold locally. It is an interesting demonstration. It might work in some communities.



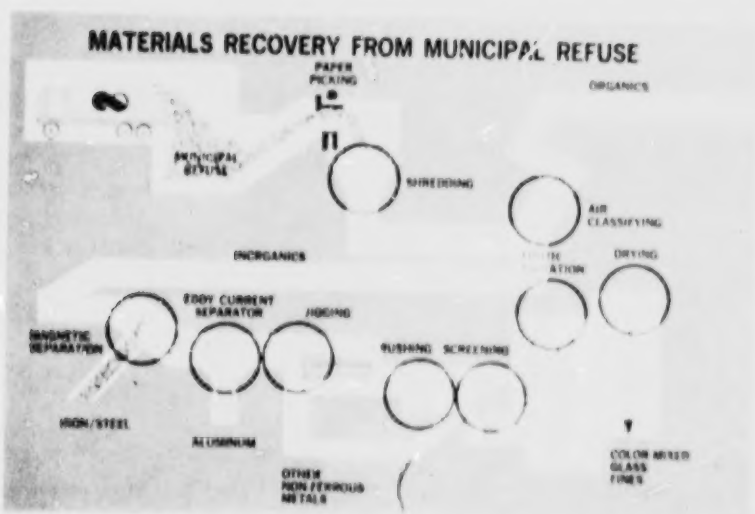
Slide 4.12

For the rest of the time I am going to talk about the waste that isn't source-separated – that mixed mass of municipal mess that gets into a compacter truck and goes to disposal or maybe to a facility like this (Slide 4.13).

The objective of materials recovery is to use equipment, unit processes, to somehow shred, sift, sort, and separate out the targeted materials that can meet a specification of the buyer and user (Slide 4.14). You can see the metals, the glass, and possibly some of the paper.



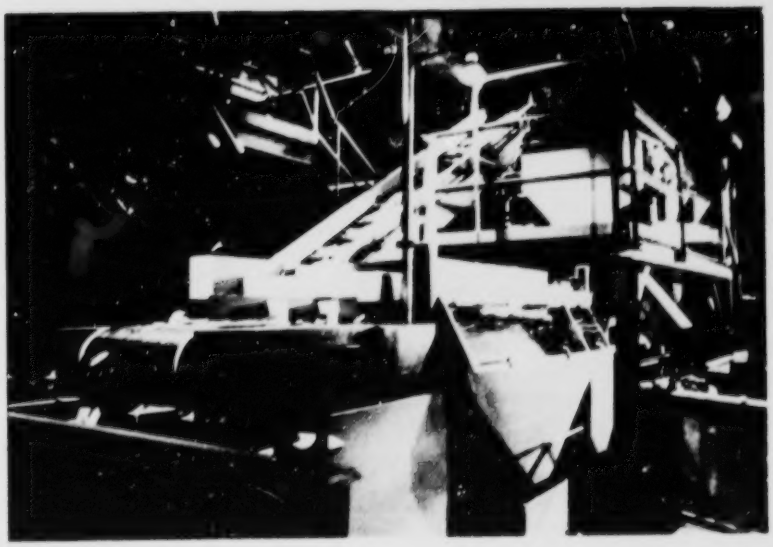
Slide 4.13



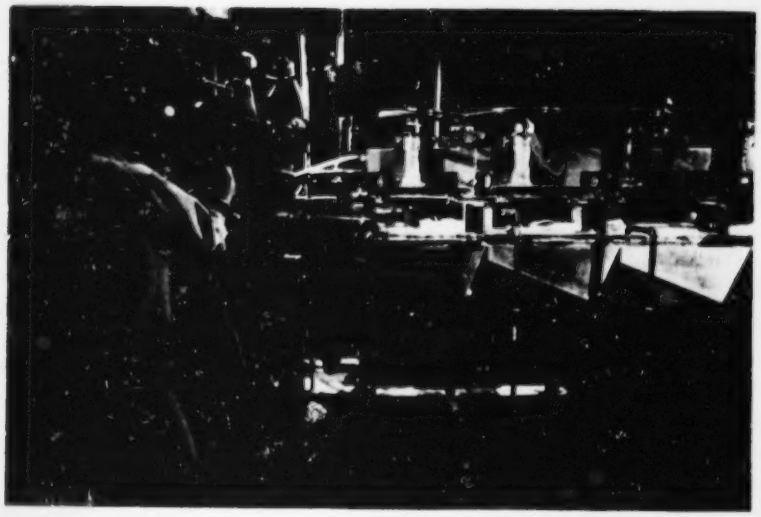
Slide 4.14

As Tom mentioned, the National Center has a pilot facility in the District of Columbia, operated in cooperation with the District government. It's located at the local incinerator (Slide 4.15). We are using D.C.'s shredder and their garbage, and we have installed various equipment -- some on loan, some that we bought, and some that we have built and borrowed from various companies, the EPA, and the Bureau of Mines. Alcoa is providing the device in the foreground (Slide 4.16) called an aluminum magnet, which separates aluminum from refuse. There is a glass separation unit (Slide 4.17) which is

Slide 4.15



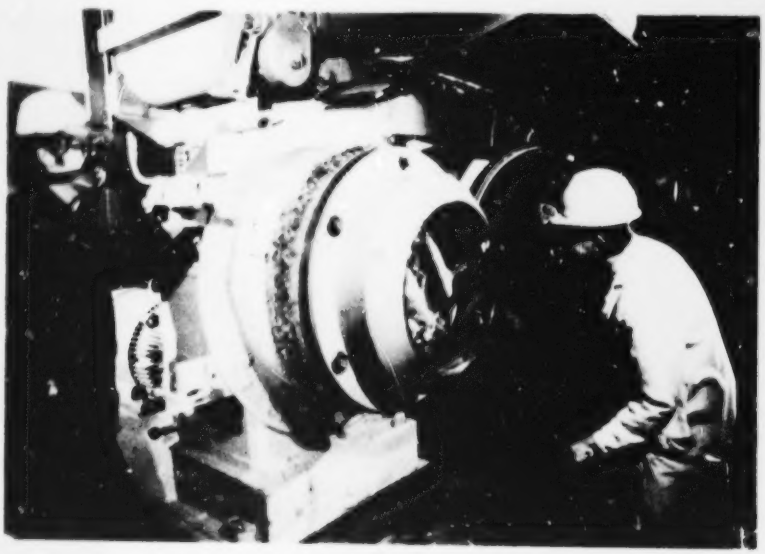
Slide 4.16



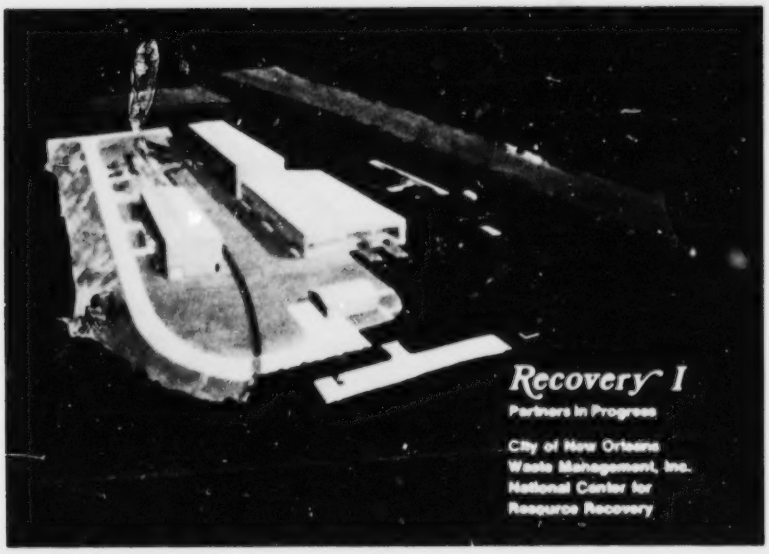
Slide 4.17

presently being installed. And this (Slide 4.18) is equipment that densifies the combustibles of garbage into fuel pellets.

A major material recovery prototype facility is beginning operation in New Orleans (Slide 4.19). Actually, the plant began initial operation in the first days of last summer, and over half the city's trash and garbage is received here. Five incinerators that could not meet air quality standards have been closed down, and an environmentally acceptable landfill is now being provided. In May, full recovery of ferrous material, aluminum, glass, and paper will begin. This (Slide 4.20) is an aerial view of the site.



Slide 4.18



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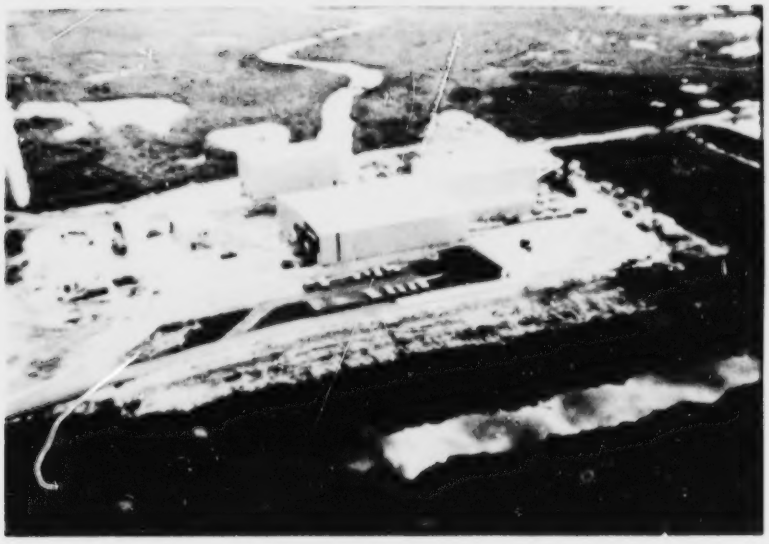
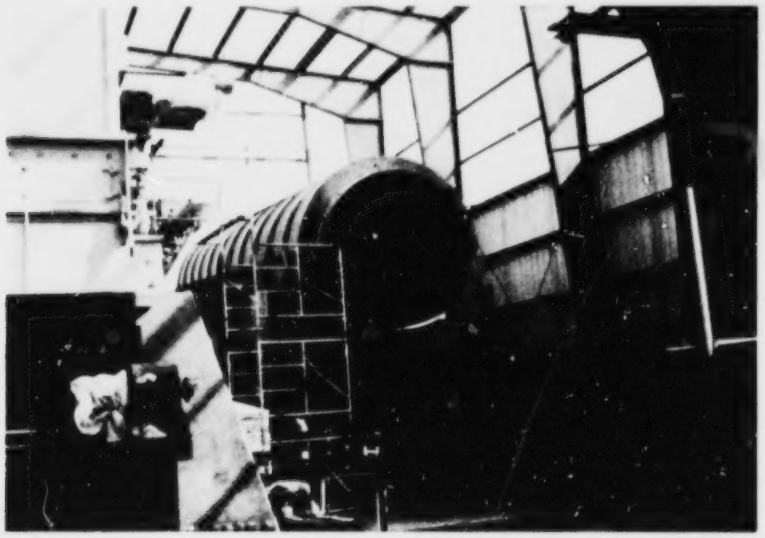


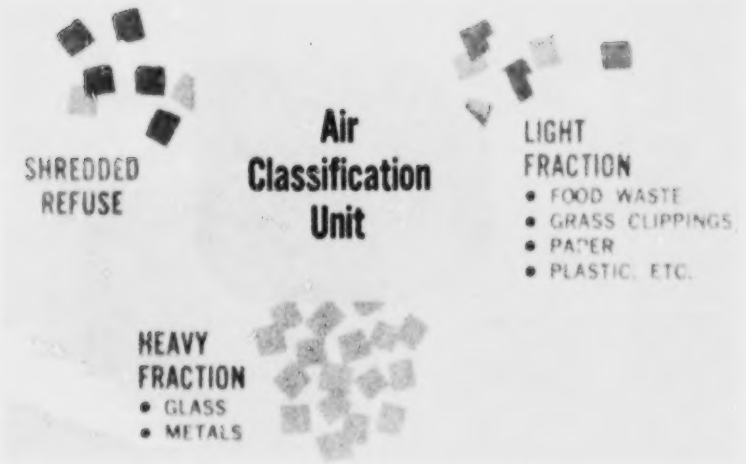
Slide 4.20

One of the devices used at this facility is called a trommel (Slide 4.21); this is an experimental device. It is unique to this facility. The refuse goes through it before it's shredded. We are able to remove some of the inorganic, such as the metal and glass, thus cutting down on the energy required by the shredder and at the same time providing a better feed stock for the materials processing equipment to follow.

A key process in both materials and energy recovery is air classification (Slide 4.22). After the mixed refuse is taken into a facility, shredded with hammer mills, and torn up into particles more homogeneous in size, the next step is to pass it through a process called air classification. A controlled air column blows off the light fraction, which consists primarily of combustibles, and drops the heavy fraction.



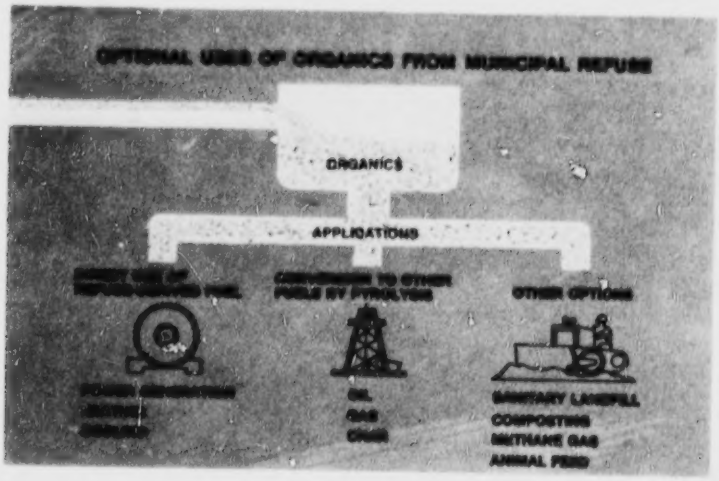
Slide 4.21



Slide 4.22

There are a number of applications for the organic fraction. Undoubtedly one of the most significant uses is as an energy source (Slide 4.23). In New Orleans, at the Recovery I site, the organics will be used initially for landfill; but in other areas it will be used in different forms of energy recovery.

Refuse has about one-half the Btu value (heating value) of coal (Slide 4.24), particularly the coal mined in the eastern part of the country. It also has substantially less sulfur; so there is an advantage there.



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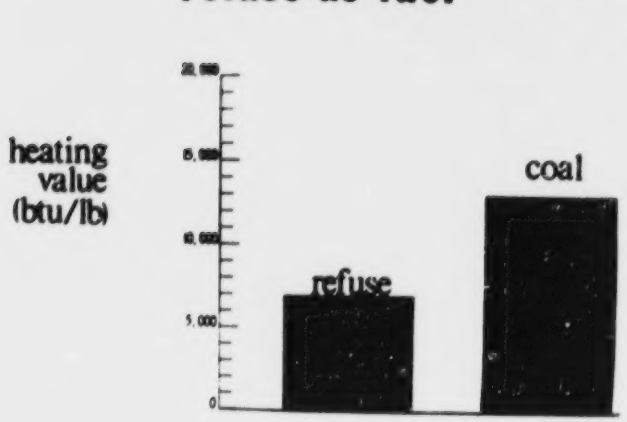
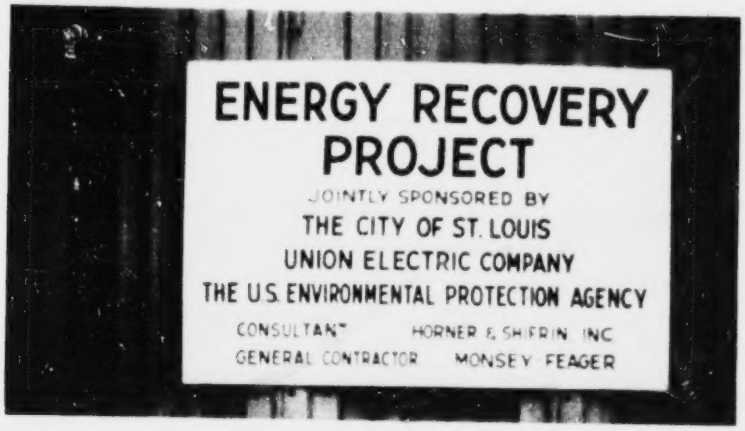


Slide 4.24

The City of St. Louis, the EPA, and the Union Electric Company in St. Louis had a three-year demonstration project (Slide 4.25). They take what we call the refuse-derived fuel — that is, the refuse that has been shredded and air classified, it's a fluff. This fuel is introduced along with pulverized coal into utility boilers at the rate of about five parts to one — five parts coal to one part of refuse. The project was successfully completed.

A number of facilities are beginning operation or actually operating using the same type of technology. This plant in Ames, Iowa has been operating since 1975 (Slide 4.26). This (Slide 4.27) is a picture of a plant that is in shakedown in Milwaukee. Later in the year 1200 tons a day will be received for materials recovery and production of a refuse-derived fuel, which is sold to the local utility. Another plant is beginning shakedown in Chicago, receiving about a thousand tons a day.



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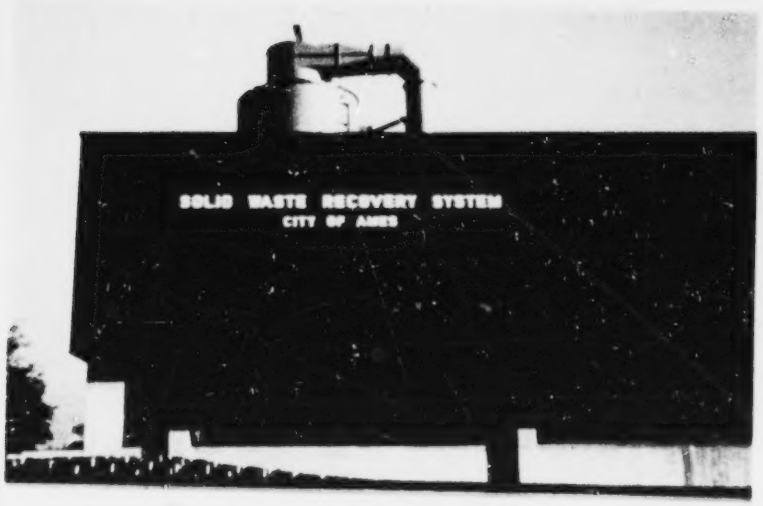
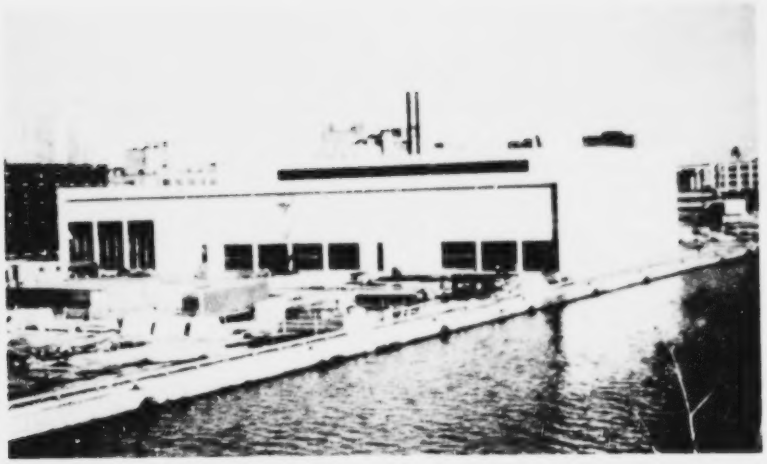


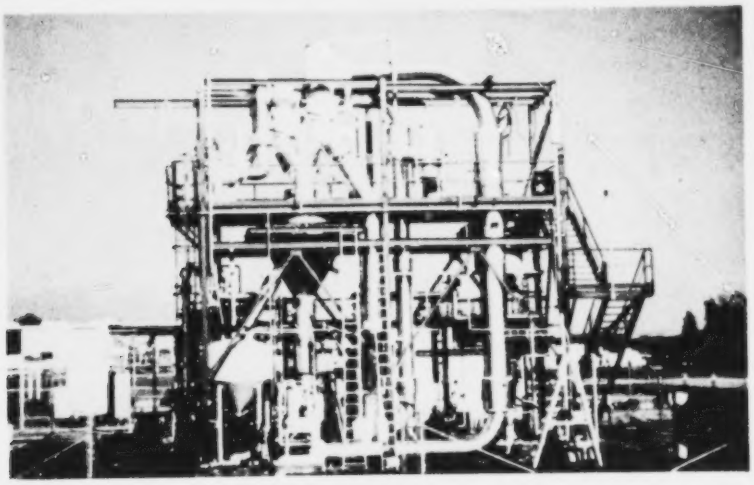
Slide 4.26



Slide 4.27

Pyrolysis is a process of taking the combustibles of garbage and literally baking them in an oxygen-starved environment. In addition to major volume reduction of the waste, there can be produced storable fuels, gases, and oils. What we see here (Slide 4.28) is a pilot plant operated by what is now Occidental Petroleum, formerly Garrett in California. This is the model for a facility which will begin demonstration in May in San Diego County. The plant is to process 200 tons a day of trash and garbage. Some materials recovery is accomplished, and then the facility will produce some 200 barrels of oil substance, which is somewhat akin to Number 6 industrial heating oil.

Another type of system called a wet system uses a liquid slurry. It was developed by the Black-Claussen Company of Parsons and Whitmore, and has been operating in Franklin, Ohio since 1971.



Slide 4.28

This also was an EPA demonstration, and it is a model for a major facility now being built in Hempstead, New York (Slide 4.29) which will handle 2000 tons a day. It will probably also serve as a model for a facility to be built in Dade County, Florida.

Some of you are familiar with this facility (Slide 4.30). It is in Nashville, and it is using more conventional technology, water-wall incineration, to produce steam which heats and cools some 30 buildings in downtown Nashville.

Another steam generation plant has been operating in Saugus, Massachusetts since late last year, doing an effective job on some thousand tons a day of refuse. The process is called mass burning; unprocessed solid waste is ignited in water-wall incinerators, and it generates steam for local customers.

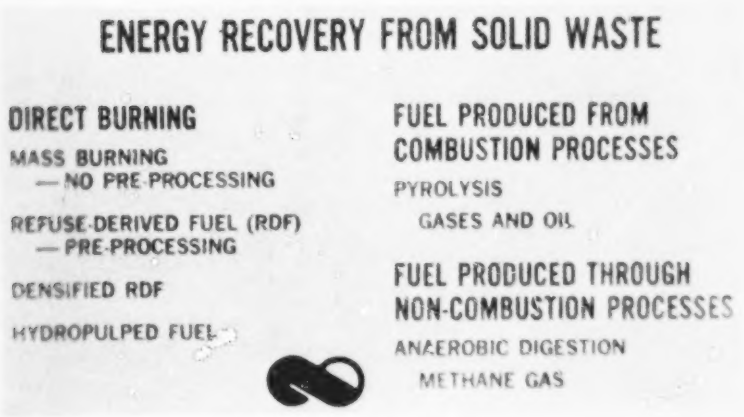
Slide 4.29

Slide 4.30

I mentioned a moment ago a test program at the NCRR pilot plant in the District of Columbia where we are spinning out pellets (Slide 4.31). We are taking the fluff of refuse-derived fuel and compressing it into pellets. It will go in burning tests under an EPA grant to see how this fuel burns along with coal in stoker-fired boilers. We are attempting to find new markets for the combustibles of garbage.

To summarize energy recovery (Slide 4.32), there is, first of all, direct burning, or the mass burning of the material. The Saugus and Nashville plants are two examples of this. Second, there is the production of a refuse-derived fuel, as well as the densifying of this refuse-derived fuel into pellets. The hydropulped fuel is to be produced at the plant being built in Hempstead, New York. Pyrolysis is the conversion of refuse to gases and oil through a destructive distillation process. San Diego County has a pyrolysis facility; Union Carbide has the Purox system which is operating in pilot in South Charleston, West Virginia, and Kotorax is another company which has such a plant. The final category is the tapping of methane from refuse through anaerobic digestion. There are two demonstrations of this last process on the West Coast which involve tapping landfills. There is also to be a demonstration to begin late this year in Pompano Beach, Florida. Supported by a grant from ERDA, the project will be using both refuse and sewage sludge; methane gas will be drawn off as a natural gas substitute.

Slide 4.31

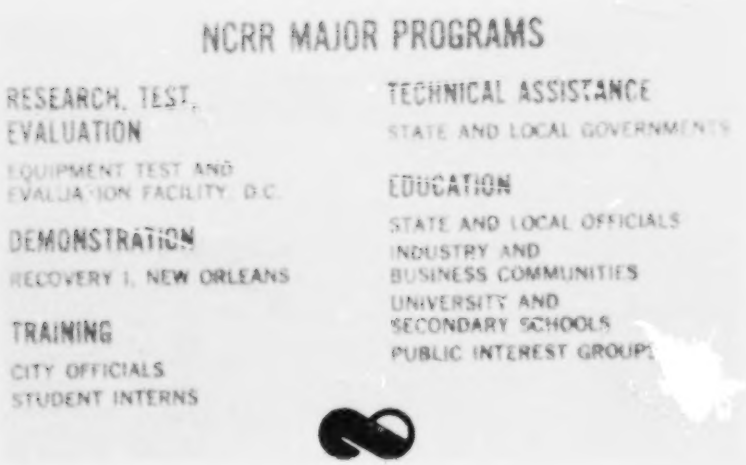


Slide 4.32

The National Center for Resource Recovery (Slide 4.33) is a nonprofit, nonlobby, research organization. Our funding (Slide 4.34) comes primarily from industry and labor; however, we have a number of government grants and contracts and foundation grants. We are involved not only in technological programs, but also the more difficult institutional and financial problems that must be solved to somehow effect recovery (Slide 4.35).

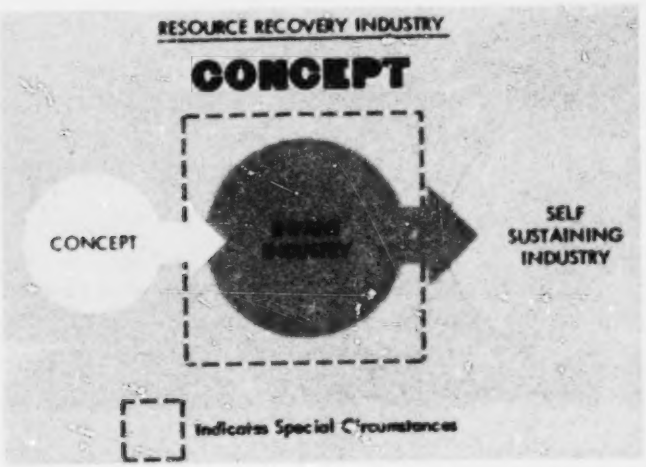
Slide 4.33

Slide 4.34



Slide 4.35

I could say in summary (Slide 4.36) that in the 1970s, resource recovery has moved from the concept stage through infancy, and is quickly passing through the development and demonstration phase. The objective and the promise is that resource recovery will reach full implementation in many cities in coming years. This objective will be difficult to achieve, but the technology is being developed now, and demonstrations are going on-line around the country. Markets must be expanded, specifications for the recovery materials and energy products must be developed, and the necessary public and private sector partnerships must be effected to make it happen (Slide 4.37).



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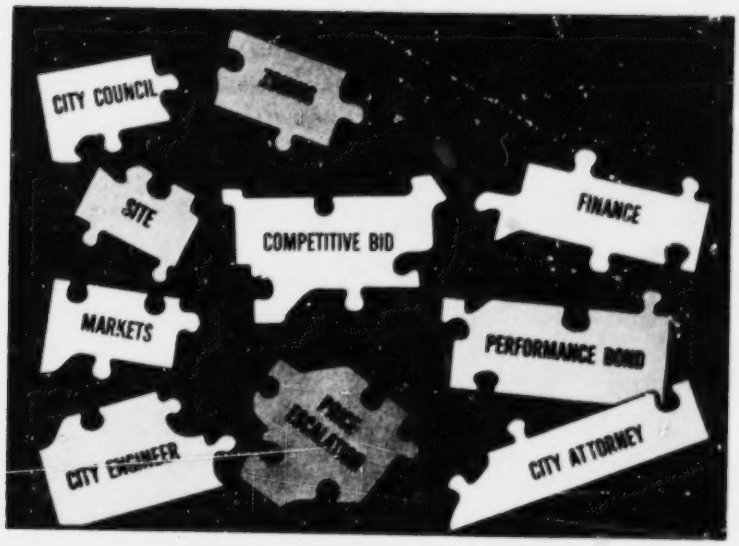


Slide 4.37

The speakers this morning talked about energy policy on a national level. There is no resource recovery policy on a national level. The new Resource Conservation and Recovery Act will stimulate and encourage resource recovery; but resource recovery is still essentially a local decision with local or regional partners to implement it.

This year there are just a handful of capital intensive plants in operation around the country, mainly demonstration or prototype in nature (Slide 4.38), although this doesn't include the 30 or more communities that are separating the steel through magnetic separation. Neither does it include all of the source separation programs around the country.

CITIES WITH RESOURCE RECOVERY SYSTEMS
IN OPERATION IN 1977

Slide 4.38

We will see by the early 1980s a dramatic increase (Slide 4.39). The 40 to 50 capital intensive plants to be on-line in the next three or four years will not make a major dent in the 145 million tons of solid waste, but they are only a beginning. What we are seeing now is a growth of knowledge and experience. This will give encouragement to communities, to consider resource recovery as an alternative to the growing and pressing problem of solid waste disposal and as a source of conservation benefits.

From an energy standpoint, solid waste combustibles can serve as a fossil fuel substitute. Further, there are positive energy implications in being able to mechanically extract recyclables for use as substitutes for virgin raw materials.

Resource recovery represents a new dimension to the traditional solid waste management system (Slide 4.40). It means no longer just collecting and disposing of residuals. It means injecting systems to recover values from what traditionally has been neglected, wasted, burned, or buried, without recovery.

CITIES WITH RESOURCE RECOVERY SYSTEMS PROJECTED TO BE IN OPERATION IN 1980

Slide 4.39

Slide 4.40

So, essentially what we are doing is moving with a concept to solve a waste disposal problem and respond to a conservation challenge (Slide 4.41).

One of the disappointments in the last couple of weeks was the announcement by the Union Electric Company in St. Louis that that company was terminating a $70 million plan for a major system to operate in St. Louis. St. Louis and the utility pioneered this development in the use of refuse-derived fuel. The company then announced it was setting up a private subsidiary with no government funding, a system to be built and to be operating this year initially, to take up to 6000 tons a day of daily refuse from the greater St. Louis area. The system was to provide about 6% of their energy needs in low-sulfur fuel (to supplement the high-sulfur Illinois coal that they were using) and to help solve a very pressing local waste disposal problem.

We have talked about institutional problems. The company decided to drop the plan because (1) the local citizens would not allow a transfer station to be sited in their neighborhoods, and (2) there was an unrelated problem of financing a nuclear power station, and there was the difficulty of getting capital, particularly since voters had turned down a proposition which would have allowed the company to raise rates to help fund the nuclear plant development now. So what was to have been the largest, by tonnage, resource recovery system in the country has now been terminated. We hope that it is only deferred.

That is all that I have on this this morning. I think I am almost on schedule. If you all have any questions I will be happy to answer them.

Mr. Eugene Banker: Mr. St. Clair, do you consider it a reasonable possibility that a small rural county area could take advantage of resource recovery in the sense you have discussed?

Mr. St. Clair: I think to make any capital intensive system viable you have to have adequate tonnage. Regional facilities will be coming on-line in years to come. States will be encouraged to promote more of the regional approach. It will be a trade-off on transportation rates to see if regional systems will be viable. In many places, particularly in the metropolitan areas, it will be viable.

Slide 4.41

For the small rural communities the best system will probably be source separation. Newspapers, for example, represent the largest ingredient, at least by weight, in the municipal trash can. They can be separated. Residents have been keeping papers separate from mixed refuse. Markets are usually available for this. Taking out newspapers can not only be a landfill lifetime extender, but it can in some cases be a revenue producer. Metals and glass can also be handled, depending on local markets.

But I think, in all honesty, in the next few years there will be very small communities that will have capital intensive plants that pay. Ames, Iowa has a 200-ton a-day facility. But they are in a fortunate position, because the city not only collects and disposes of the refuse, it owns the utility. The city is a provider of a supplemental fuel and a user of it, so they are able to internalize the cost.

5. EMERGING PERSPECTIVE ON ENERGY DEVELOPMENTS IN APPALACHIA

Donald W. Whitehead

Chairman Tom Waldrop: Our next speaker, and the last speaker of the morning, is Mr. Donald W. Whitehead. Mr. Whitehead was appointed federal cochairman of the Appalachian Regional Commission by President Nixon in March of 1971 and was confirmed that same month by unanimous vote of the United States Senate. His executive leadership and efforts on behalf of the Commission during the last four years have been instrumental in assuring passage of new legislation to continue the program past 1975.

A resident of Stoughton, Massachusetts, Mr. Whitehead first joined the Commission in 1970 as general counsel, and served in that position until his appointment as federal cochairman. Mr. Whitehead has represented the needs of Appalachia on many national, as well as regional issues. He has testified before the Congress on various subjects, such as the regulation of surface mining, railroad abandonment, and health care in rural areas. In his role as federal cochairman, he has helped the Appalachia program develop into a model for the entire nation.

As an attorney, Mr. Whitehead has a long history of involvement in public affairs and public service. Before coming to Washington he served as assistant attorney general of the Commonwealth of Massachusetts; he has also served as a legislative assistant to Congressman Hastings Keith, as assistant legislative counsel for the John Hancock Life Insurance Company, and as a consultant for the New England Council for Economic Development. He is also a partner in the law firm of Hahn and Whitehead.

Mr. Whitehead was born in Auburn, New York, and graduated cum laude in English from Williams College in 1951. He received the Doctorate of Jurisprudence from Northeastern University, also cum laude, in 1955. Mr. Whitehead received a fellowship in public affairs from Tulsa University Civil Education Center in 1960. I also found out that he has a very soft spot in his heart for the State of Tennessee; he seems to be better acquainted with this community than a lot of the natives. His subject this morning is "Emerging Perspective on Energy Developments in Appalachia."

Mr. Donald W. Whitehead: Thank you, Tom. Ladies and gentlemen, this isn't the first energy symposium held anywhere in the nation. I am sure that many of you, like myself, have attended many such conferences before, but I hasten to point out to Tom and his colleagues that it is not always necessary to be first. I think this is a first-rank conference. I have found the caliber of presentation exceedingly high, and with your indulgence I am going to alter my planned presentation slightly to see if I can more compatibly fit in with the other presentations you have heard this morning. I would like to change some of my emphasis so that I can eventually develop a little bit of presentation on some of the public policy issues inherent in our discussions.

For the reasons that were so well documented by Mr. Patton and Mr. Gibbons, the Appalachian Regional Commission is guardedly bullish on the prospects for coal development in Appalachia and for coal production and coal employment. In the next eight to ten years, between now and 1985, we can see

prospects for perhaps a 30% increase in production. This will arise not entirely out of governmental policies, although that will be the eventual underpinning and the most important consideration for the effect on the future, because it is obvious that solar, geothermal, tidal, wind, and the other exotic energy sources are far into the future. It is obvious that nuclear power, important as it will be, is having problems with the environment and with assuaging citizenry concern over safety. We are thus developing a greater interest in the mandating of fueling new plants up with coal, rather than with other energy sources.

Of course, we see the prospects for rising costs for competing fuels, and the public is increasingly restive about being dependent on unreliable foreign sources, particularly from the tempestuous Middle East. In the long term, we see even greater prospects for coal, particularly as advancing technologies permit breakthroughs in synthetic fuels.

Of course, we recognize that it is less expensive, generally, to mine coal in the West where the deposits are so much greater. In this sense perhaps the synthetic fuels industry is first thought of as being western-oriented and -located, but that is not necessarily so. We think that westerners are considerably concerned over some of the impacts of accelerated development of the coal and allied industries. The appointment of Governor Andros as Secretary of the Interior is a signal that the Carter administration is going to be sensitive to the views of conservationists. I think we all recognize the high cultural value which most westerners place upon their landscape and their present life-style, and they are going to take steps, I think, to try to preserve those factors. The scarcity of water in the West is going to be a basic retardant of the synthetic fuels industry. None of us know what the radical stripping for coal is going to do to western water tables, and we are very aware these days that water and water shortages are an imminent problem in the West.

So we expect Appalachia to get its fair share of the synthetic fuels industry. After all, it is closer to the markets, and not only has the coal but certainly has the water and the people to mine and transport it. For these reasons we are optimistic about the growth of the industry in our region.

With regard to the impact on Appalachia, of course, we immediately think of the increases in employment, the increases in money flow and turnover, the bursts to our economy, the prospect of developing for the first time a diversified industry, the prospect for developing not only industries allied to coal, chemicals, and petrochemicals, but also prospects of developing for the first time a genuine service industry. These prospects give us some hope that within our lifetimes the Appalachian region could develop a genuine, self-sustaining economy and join the mainstream of American economic life.

If so, we would see the first stop in the tremendous out-migration of people from Appalachia in this century. As you know, there has been a virtual historical hemorrhage of the best and the brightest from the region, who have had to leave in order to pursue careers elsewhere. So, perhaps Governor Carroll is correct when he predicts that Appalachia stands on the verge of a virtual explosion that will provide the region not only with the economy but with the strong tax base it needs to move forward in twentieth century America.

But we must remember that this is not an unmixed blessing. Appalachia has always been rich in natural resources. Those resources have not inured to the benefit of many of the residents of the region. The profits have frequently been siphoned off and have not reached the average citizen. It has not been possible in many communities of Appalachia to develop the kind of governmental system and tax base where the coal industry has paid its full and fair share of the costs that coal production imposes upon the community. Appalachia has been through periods of boom and bust in the past, but it has not created a self-sustaining economy or a diversified economy. The coal industry has, instead, left a region (particularly in central Appalachia) terribly scarred with the ravages of stripping.

Now, maybe we are better prepared this time around. Maybe being aware of the problems and the mistakes made in the past, we'll be guarded. Perhaps new legislation, now on the books or being seriously considered, will protect us from some of the worst abuses of the past. Perhaps the development of new institutions in and out of government is going to be helpful.

I think, for example, of the kind of multicounty development agencies which the Appalachian Commission and a number of other federal agencies have helped develop and support throughout the region. So, perhaps we can maximize the pluses and minimize the minuses in the burgeoning coal production situation.

A word on the Appalachian Regional Commission: It was created by Congress in 1965, not as a federal agency but as a partnership between the federal government and 13 states. The region has been defined by Congress as including all of the state of West Virginia and parts of 12 other states, straddling the Appalachian Mountains and going from western New York all the way to northern Mississippi and Alabama. It comprises almost 10% of the land area of the continental United States and about 8% of its population, better than 19 million people. This is an area that has historically been a virtual backwater of development. Certainly in 1965 it was at the low end of practically every indicator in terms of income, death rate, morbidity tables, substandard housing, and so on.

The Commission was given the authority to engage in certain basic programs. We are the creature of the Public Works Committee of the House and the Senate, and so there is an emphasis on the importance of public works and intrastructure in a community's growth and development. For example, about 60% of our money has gone to the construction of a network of highways to supplement the interstate highway system. This was done in order to attack perhaps the region's basic problem: its isolation from the rest of America because of the mountainous terrain. We have designed a system and launched an aggressive attempt to construct some 3000 miles of such highway, virtually to interstate standards. Half of that system is completed or in construction.

We have also virtually completed a regionwide complex of vocational schools—better than 500 of them—seating over 310,000 students, in order to provide our young people with hopefully relevant skills that will lead rather immediately to employment. We were also asked to demonstrate new ways to deliver health services to a world population which in many instances did not have ready access to doctors or other medical technicians.

We were given a specific charge to clean up some of the past ravages of mining, and we have developed a program. We have now extinguished virtually every major mine fire in the region; it cost us millions of dollars to do so. We have put millions of dollars underground, particularly in Wilkes-Barre and Scranton, to tackle the subsidence problem in those communities, which a decade ago were on the verge of collapsing into abandoned coal mines. We are also trying to clean up some of the gob piles around the region. Interestingly enough, West Virginia and Pennsylvania are both demonstrating the potential use of coal refuse to build highways—not for surface aggregate, which is frequently employed in this country, but for a fill. That would really be motherhood, if we could clean up coal refuse at the same time we built our roads.

We are promoting a modest program in low and moderate income housing, and we have the authority to supplement a grant made by any federal agency in order to increase the total federal share to 80% of project cost. This has put us in the water and sewer business with HUD and with the Farmers Home Administration.

The interesting thing, however, that I would like to bring to your attention about the Commission is the institutional aspects of this agency, because it is an attempt to create a different kind of an animal than another federal institution. It is a partnership between the states and the federal government, as I said. What does that mean? It means that Commission policy is determined by the members of the

Commission, who are the governors of the 13 Appalachian states and a representative of the Administration, called the federal cochairman. He has that title because it is supposed to suggest that there is a state cochairman, and there is; the governors serve in rotation in that office. Currently the state cochairman of the Commission is Governor Marvin Mandel of Maryland.

The Commission is given very broad statutory authority in the program areas that I enumerated. It is up to the Commission itself to make the decision as to how it is to allocate its money among those various programs and among the 13 competing states. Those are very important decisions, and the ground rules under which we make those decisions are jointly determined by the state and federal government, because they are determined by a vote of the Commission itself. In other words, you have the very unique situation of the potential recipients of federal grant funds writing the guidelines under which those grant funds will be dispersed. It gives the states an opportunity to confront the federal government on other than a subservient basis.

In the most recent legislation extending the life of the Commission, the Congress required us, before making a decision on the establishment of a program or the funding of a project, to consult with local elected officials and civil leaders in these organizations called local development districts. As you know, problems do not neatly stop at political boundaries, and virtually all the intense problems we face today in the field of government require cooperative undertakings between different political jurisdictions; they must be solved on an areawide basis, some of them on a multistate basis

In order to have an institutional entity to make that kind of input into our process, we have encouraged the formulation of multicounty planning and development agencies, which are also supported by HUD, the Economic Development Administration (EDA), and others. The law now requires our governors, before making a decision as to their own plans and their own applications for Commission money, to consider the priorities that are established by the boards of directors of these local development districts, a majority of which consist of elected officials.

I suggest to you that the determination of priorities in a system of distribution of federal grant money is a very important and very controversial kind of decision because the establishment of priorities is something on which reasonable persons can disagree. The ordinary process by which government works does not really permit, in my opinion, adequate input from local elected officials or state elected officials. We have too much gone with a system that gives to a federal bureaucracy the authority to unilaterally make decisions that are imposed upon local communities.

Before I range too far afield, I want to note that in addition to the programs I described which the Commission has undertaken, we do have a rather ambitious research program. As a matter of fact, I have with me (and my associate, Mr. Mollick, has further copies of it) a compendium of the research that the Commission has undertaken over the years.

We also have a role, of which we are increasingly aware, of presenting the region's needs in an advocacy sense to federal agencies. We are increasingly working with HUD, ERDA, EPA, and EDA in that sense. This was a role which did not easily come to the Commission. In the early days the Commission largely saw itself as simply another source of federal grant money, and the Commission found it difficult to get involved in broader public policy questions that were inherently controversial. But through the goading of some of the more articulate and aggressive members of our staff, we have eventually encouraged our state partners to begin getting into these areas.

One of those who in the early days was most effective in making this kind of case for the future development of the Commission is a Tennessean who is here this morning, Jim Branscom. He was with the Commission for several years and was an outstanding advocate of our need to develop this kind of role. I am glad to see him in the audience.

In that advocacy with federal agencies, we undoubtedly considered our responsibility to become more supportive of efforts like that of Senator Jennings Randolph who has long been an advocate of coal and coal development. For those of you who are interested I have a reprint from the January issue of the coal mining journal *Mining Congress Journal* that contains a transcript of remarks Senator Randolph made in Charleston, West Virginia last November at an eastern coal forum. This might be particularly interesting for those of you who deal with the Environmental Protection Agency. I have further copies and I will be glad to distribute them later.

We all know that although there are technical problems (how we get sulfur out of coal and so on), the real issues inherent in energy, as in any other aspect of modern life, are the public policy questions. They range in complexity and include such things as, Shall we insist upon a 55 mile per hour speed limit? Shall we attempt to legislate mileage performance by automobiles? Shall we relax stack emission standards or pick some other criteria? Shall we impose a national coal severance tax? Shall we regulate stripping? Can we do so in a manner which recognizes that in many Appalachian communities one of the basic problems is the lack of developable land, thus developing legislation which generally requires the stripper to return the land to its original contour, except in those cases where the land can be devoted to a higher use if it is kept flat? Can we do that without giving the strippers a loophole that will mean they can continue unfettered stripping? Should we deregulate natural gas? If so, how would we do it? Who will finance the development costs? If we opt for a policy in this country of more immediate accelerated coal development, who is going to pay for the schools, hospitals, roads, and all the other things that will be necessary to provide for those who do the mining and the transporting of the coal?

How is that kind of decision to be made? I would suggest to you that a so-called national policy, in the way that it is traditionally discussed, is hopelessly inadequate to that task. The Congress of the United States can pass legislation, but I don't think that provides for national policy in the truest sense; I think that creates federal policy. I think under our system of government we cannot have a truly national policy until we recognize the importance of state and local government and the necessity to involve our resources and our people at state and local levels in that kind of a decision. We have got to talk in terms of a national policy, in terms of developing a process by which we can get input from the public at large and from those they elect to office at the appropriate stage of the decision-making process, and that is the difficult thing. We all want to involve the public, but how and when?

I have found in moving around the region, the not surprising fact that most communities want to be the site for a regional vocational school, but few of them want to be the site for the trash collection. So if we left those decisions entirely to locals, we would have everyone clamoring for schools and no one permitting dumping. It is simplistic to expect that through a series of hearings at the local level we can count noses and make public investment decisions of that character. It cannot be done; it is much more difficult than that.

But how do we do it? How do we gauge what public opinion is? In the last analysis, that is what we all want to know, and that is what our elected officials need to know. Unfortunately, the electioneering process, particularly in recent years when it has become so dominated by the media, does not really focus on issues as much as it focuses on personalities. Therefore, following an election we generally do not have a clear-cut mandate from the people on basic issues confronting us. If we want to construct a system that preserves the opportunity for all of us to make the kind of contribution we want to be able to make, we cannot surrender either to elitists' special interest groups, either in government or out of government.

We have got, I think, to recognize that we pay a heavy price for our federal system of government. The fact that this is a republic is probably the source of our most important rights as American citizens. The federal system is probably our greatest defense against overbearing government; so personal freedom and liberty, as we understand it, is probably dependent upon our federal system. But let's also recognize that we pay a heavy price in inefficiency for such a system.

Let us also recognize that under Article 10 of the Constitution of the United States, the federal government is the creature of the states. Powers not specifically delegated to the federal government are reserved to the states. Let's not forget that we elect mayors, city councils, county supervisors, county judges, governors, state constitutional officers, as well as presidents and congressmen. Every time we do, we have placed in office someone who has legal, statutory, constitutional responsibility and independence, and an opportunity to serve his constituency as he sees them.

Governors aren't answerable to presidents. County judges aren't answerable to governors. We don't have a hierarchy in this country where the word comes down in that sense. Yet, we frequently talk as though we could make public policy decisions at the pinnacle of a supposed hierarchy ranking local, state, and federal government and have those decisions somehow translated into implementation by state and local officials.

It doesn't work that way, and we incur a great deal of trouble when we don't recognize it. We are not going to be able to deal rationally in a way that gives communities an opportunity to express their values on growth or no growth, on energy and environment, or on any other issues that confront us until we put in place a process that links together the separate levels of government and provides interplay between the public and private sectors. We are not going to be able to solve that kind of problem until we develop new institutions in this country to tackle them.

And people like yourselves, who have a highly sophisticated understanding of an important field that impacts directly on public policy, have a particular responsibility to examine proposals that come forward from time to time in an attempt to establish a new kind of institutional framework in which this kind of interplay can take place between the public and private sectors and between the several levels of government. You have a special responsibility because you have a special contribution to make as a result of the knowledge and experience you have acquired. I challenge you to discharge that responsibility.

I think it is particularly fitting that I make those remarks here as a guest of the Energy Opportunities Consortium, which is exactly the kind of organization I am talking about. It represents a remarkably innovative and imaginative advance, providing as it does a forum for business and industry to deal with government on common problems. We need more of the same if we are going to solve our energy questions or anything else. Thank you very much.

6. ENERGY CONSERVATION—OPPORTUNITIES AND BARRIERS

Grant P. Thompson

Madam Chairman Nelda Harrell: The first speaker of the afternoon is Grant Thompson. Mr. Thompson is with the Environmental Law Institute. He is that rare person who is a real native of California. He told me that he was not from Pasadena, but South Pasadena.

He holds degrees from Pomona College, Oxford University, and Yale Law School. Mr. Thompson is an Institute Fellow, director of the Institute's Energy Research Program. He is principal investigator of the National Science Foundation–funded study of Energy Conservation Strategy at the state and local level. He is also project manager on the National Science Foundation–funded study of solar energy and land use.

He told me this morning that his wife is an engineer, and that he is sure his six-year-old son is going to be a scientist because of his obsession with Star Trek. Grant says he thinks of himself as an environmentalist, but some days he thinks he may die of fluorescent lighting poisoning.

The Environmental Law Institute is a nonprofit, private, nongovernmental organization. It does not bring lawsuits, nor does it lobby. Instead it's a research and publishing organization.

Grant has authored two books recently, one that is already out is entitled *Energy and the Social Sciences,* and one that I thought sounded very interesting will be out this spring, *Building to Save Energy*. Grant, who deals in energy conservation, practices what he preaches. All his friends know that when they go to his house in the wintertime they are supposed to bring sweaters and be prepared to keep them on, because he keeps his house at 55° in both summer and winter. Somehow that seems to fit with the topic that he has chosen to speak to us about today, "Energy Conservation—Opportunities and Barriers." Grant.

Mr. Grant P. Thompson: Thank you, Nelda. This morning we have heard what one can call the bleak side of energy. But the real bleak side, if one looked at those statistics and wondered about capital shortages or looked at the environmental consequences of doing what seems necessary to continue those higher growths, is not a happy circumstance for the American public. This is particularly true when one comes at it as I do from an environmental point of view, with concern about residuals management, land use complications, air pollution, water pollution, thermal pollution and so forth. It is a difficult and not very happy prospect.

I am reminded of a panel of lawyers I was on a few weeks ago. Three topics were covered. One of the topics was strip-mining of western coal. The second topic was development of geothermal resources, and the third was energy conservation. Afterward, somebody came up to me and said, "Well, that was a balanced panel because you talked about claw it out, punch it out, and do without." That person made the point that there is a confusion in the American mind about when to use the word conservation. People tend to think of curtailment, the kind of thing we went through this winter. This winter's actions were not conservation. Chilly rooms and crowded buses and idle industrial plants are exactly the kind of thing that energy conservation is designed to keep from happening.

The title of my talk is "Opportunities and Barriers." Let's talk first about opportunities. We have seen on the screen some predictions about the possible future of supplies. The opportunities for energy conservation span an enormous range of estimates. Dennis Hayes of the World Watch Institute has suggested that we could maintain the same standard of living and live as comfortably and as happily as we do, using about 50% as much energy per capita as we do now. Other estimates range around savings of 35%. I wish I could give you an actual range for energy conservation, but I can't. There are two reasons for that difficulty. First, one always has the difficulty of proving something that has not been proven. It's a little bit like asking the question, "How much overweight is America?" Well, who knows? But particularly in energy conservation one has the problem of defining waste. How do we know what it is that we want to eliminate and how much do we eliminate so that we stop cutting off the fat before we start going into the muscle?

It seems to me the key point is costs and benefits. In fact, that is the way, in general, that energy conservation has been defined in this country: a way of looking at efficiencies and making energy conservation investments, at least up to the point at which it pays you to do that with the discounted fuel values. We don't know exactly what kind of discount rate we ought to use on future choices. We have absolutely no idea what future fuel costs will be. We have all of these uncertainties that make the break-even point of practicing conservation very difficult to pin down. That tends to give the nation a bias toward supply options because in general we can say that if we have this kind of an investment in a power plant or in off-shore drilling, we will get this kind of return, which makes it much harder to talk about that savings factor. The savings, however, is enormous, particularly when compared to other kinds and ways of creating energy. Jack Gibbons this morning showed us a slide that showed that insulation cost us $4.90 a barrel of oil equivalent.

During a discussion with the energy manager of one of our major chemical companies, I was told about a process in which they are making large investments, in an energy conservation area. He said that companywide the Board had determined that this process had the highest rate of return of any investment that could be made by that major company any place in the world. Eric Hirst and others now at Oak Ridge National Laboratory have been looking at improvements in such areas as refrigeration. Some of the improvements are really quite trivial, like moving the fan motor that blows the air in your frostfree refrigerator, moving the motor outside so that you don't heat that air. They have payback periods of three or four months—investments that we clearly ought to make. Those are the outlines of the opportunities.

Then one says since we have this wonderful product to sell called energy conservation, why is it that we haven't done it? What has gone wrong with this nation?

I think there are at least three problems that we face. First, there is a certain American optimism, an optimism that says it can't happen here; this is just temporary. I think the public believes the devils are the oil companies; let's string up the public utility company or, the most sophisticated say, the public utility regulator. Well, it obviously *has* happened here if one looks at any responsible estimate of future energy prices or energy supply. We are on the upward part of the slope on prices, and for many traditional energy sources we are on the downward side of easily available resources.

The second problem is that American optimism is translated into the concrete laws, regulations, and building and trade customs. And it's that institutional and legal set of barriers that interests me and forms the center of my own research interests.

Finally, the price of energy in this country is set well below the cost of replacement, so that consumers get the wrong kind of signals when they are making investment decisions and purchase decisions of energy as well.

The government tends to think in terms of funding decisions; we think that legal and institutional barriers (because you can say it in a phrase) are a single, identifiable object. It is usually an object called *they*—only *they* would do that; people believe that some kind of a simple-minded solution will solve it. That, in fact, is not so. The people in this room, the various professions we represent, all represent part of those legal and institutional barriers.

Take for instance a very simple action. We know that it is advantageous to put more ceiling insulation in new construction than we now do. How do we go about doing it? Suppose a new subdivision is being built north of this city and we want to force them to put more ceiling insulation in. You don't just pass a law, because you already have a law there called the building code. The building code wasn't created by the City of Knoxville—almost no cities now create their own building codes with the exception of New York City, and when New York City did a revision it cost them a million dollars. That sort of thing would be difficult for most cities to afford. So instead we go to private groups called national code groups. Those national code groups are voluntary associations of code officials and they arrive at code changes by a process known as consensus.

Now what does that mean? Consensus means that if you are going to make a change in something as simple as building insulation, you have to check with all of the people it may impinge on. That includes engineering groups, including the one I belong to—ASHRA; the heating and refrigeration industry; the industry groups, such as the American Gas Association, which certifies for safety; the unions which will have job impact; the furnace manufacturers who are impacted because with more insulation you need smaller equipment. You continue this consensus process, through draft and redraft, until you finally get something on which all of those private parties agree, and I want to emphasize up to this point it's a private instrument.

Then the national code, through one of the code groups, negotiates until finally the change is added to the code. Now we have it in the national code. Do we have it in Knoxville? Not at all. The code has no legal effect and has to be legislated either by the state code group or by the city council, depending on who controls the building code. So all of those forces that have fought—and maybe in some cases have lost—issues nationally have a chance to reopen the issue. If one looks carefully at the code process throughout this country, one finds that a significant number of jurisdictions are as much as seven to ten years behind in making changes in their code; that is, they are just now beginning to adopt those things which were adopted nationally in 1966.

When we talk lightly about legal and institutional barriers, what we are really talking about is my self-interest or somebody else's self-interest, and we are not talking about any kind of generic thing; it is a process. In its best sense, it is a political process, and we must learn how to speed that up and refine it while still taking into account all of the legitimate interests in it.

What have we done so far? We have heard a little about the federal level this morning. I would like to go over it quickly. I think the federal programs basically involve three items. First, the federal government through the law and through voluntary actions of the President has tried to exhort people or educate them to conserve energy: "Don't be fuelish," and so forth. We Americans have a tremendous belief in education; Jefferson said if we have an educated populace, things will be all right. Those education programs set the stage for the right kind of action, but in my opinion they are not sufficient and should not be relied on as heavily as the government has done. Second, the government has a few mandatory programs. They have tended to be a little bit bold in concept but very timid in execution, and I will talk a little bit about those in a minute. Finally, and I think most interestingly in this federalism of ours, the federal government has bravely passed all of the difficult questions on to the states to solve, and has then gone off and not given them very much aid to do that.

These three policies -- the education programs, the few mandatory programs, and the state programs -- appear out of two laws, the Energy Policy and Conservation Act (EPCA) and the Energy Conservation and Production Act (ECPA). The EPCA has a number of programs. The conservation ones deal principally with automobile efficiency. In that area the act calls for a weighted fleet average going up to 27½ miles per gallon by model year 1985. It's a good thing to do. One can wonder whether the government shouldn't have tried to think of something more innovative about load factor to try and get more people into each car. This is a very difficult area in a democracy, but at least some economic incentives could have been made in an attempt to increase the load factor.

The EPCA also covers consumer product testing, labeling, and standards. The testing and labeling programs are mandatory federal programs, but the FEA has missed deadline after deadline on them. That is a shame because, as materials from Oak Ridge show, there are a lot of easy, cheap things that people can do that make a big difference. In fact, Eric Hirst did some work that was published both by Oak Ridge and in *Science* magazine showing that the fastest payoff in the residential field occurs by increasing the efficiency of household appliances. This could provide the possibility for mandatory standards, but that looks unlikely until 1980 at the earliest.

The third thing that the EPCA covers is a reporting requirement for industrial energy users. The largest energy users are called upon, identified, and given voluntary targets; but the only time they are punished is when they don't report whether or not they meet these targets. And, of course, there are state programs that I will come back to.

The second law, the ECPA, is an extension of the earlier law. It adds to the first law utility programs involving rates. The FEA is doing some timid testing in this area; they are putting out a report to Congress in a week or so in which they cover the effects of rate design, among other things. That report doesn't make recommendations, but it seems to favor an effect. It describes time-of-day pricing in which relationship between on-peak and off-peak pricing is related to system load factor. The ECPA also covers standards for new buildings and weatherization, and then also adds to the state programs.

I have referred several times to the state programs, and I would like to talk about them for a few minutes because that is my area of interest. Stimulated by the earlier act, the EPCA, the states were called upon to develop conservation programs that would show by 1980 a 5% diminution in the amount of energy used. There were five mandatory programs: thermal standards for new buildings, van pooling, lighting, government procurement, and (as a tag-on) right turn on red light. The supplemental act, the ECPA, encourages information activities and energy audits of buildings.

Almost all of the states have responded to the federal dollars that are available under the state program. The District of Columbia is foregoing participation in the program because they have decided that right turn on red light is too dangerous in the metropolitan area. Some of the states have made exciting developments. They have taken the stimulus of their own interests plus the federal money. I think of two particularly: California and Minnesota. California has developed, under the Energy Resource Development Conservation Commission, residential and appliance standards which are becoming pace-setters for the nation. Minnesota has taken a comprehensive look at energy and is developing, among other things, building standards. There is a housing financing authority there where you can get loans and, in some cases, direct grants for retrofitting your house with insulation. I think the states that are looking generically at energy conservation are the exciting ones.

I have brought along a single copy of a publication called *ECP Report* that the Environmental Law Institute puts out under a National Science Foundation grant. This issue contains a state-by-state listing of energy conservation legislation, both enacted and proposed. If you would like to receive an issue of this and get onto our energy mailing list, give me your name and address and I will make sure you get a copy of it. We have eight books coming out of this National Science Foundation-funded research that

will be published late this spring. They deal with law and regulation at the state level and what you can do in your own sectors.

To close, where should we be going on the regulatory programs and those things that law can affect? First, I think we ought to be following up on the issue of price. This used to be an economist's business, not a lawyer's. In fact, something over half the energy used in this country is subject to regulation, and at least in principle all of it could be.

There is one problem with the present pricing of energy that I would like to highlight. Energy is sold to the ultimate consumer at a price which reflects a kind of average, taking into account the cheap prices that we had when it was cheaper to generate or discover energy and the more expensive prices we have for the new sources of energy. Commissioner Berlin made the point that there is $200 and $1,000 electricity on the same system in New York. When somebody is turning on a light or buying an air conditioner, they do not see that $1,000 electricity, though it is going to cost the nation or the consumers in New York $1,000 to replace that electricity in order to build an additional generating capacity. In fact, what the consumer sees is a price between the $200 and the $1,000 electricity. So simple economic theory tells you that because the price is too low, people use too much of it.

The most scandalous area for this, of course, is interstate natural gas. In Texas it is sold at $2.00 Mcf, and in the interstate market there is gas passing for the traditional price of around 50¢ Mcf. People are paying toward that low end, and of course they use too much and also don't insulate their houses.

Second, I think that we must move toward more mandatory programs. I am a great believer in the pressure of price: it hits all those people who don't read the newspaper and who say there is no energy crisis. It hits all of us in some way. There has been a tremendous interest, for instance, in Washington, D.C. in insulation, and last winter there was no interest in insulation. So I like price, but I think there are some areas where we really do need mandatory programs.

A market and the price signal only work when there is good information for consumers. Housing is a classic case in which we don't have good information to give consumers. When you buy a house, your contractor can't tell you easily, and probably wouldn't tell you, how much it is going to cost to heat and cool it. If you rent an apartment, the man who owns the apartment building doesn't care whether there is any insulation since you are paying for the heating and cooling. Those are areas in which we need mandatory programs. We need to have stricter mandatory standards for appliances; we know the goals that are possible, and we ought to move toward them faster than we can by price. We ought to do it in cars, and in certain other major consumer areas.

I want to close on the theme on which I started—energy conservation. A lot of us worry about this. We worry about the correlations between the good life, which in this country we tend to equate very closely to gross national product, and energy use. Parenthetically, one might look at the decade of the 1960s. This was a decade in which our gross national product was rising very quickly. We might wonder as a nation whether we were happier in 1970 than we were in 1960. I suspect, for all kinds of noneconomic reasons, that we will find that the gross national product has very little to do with what we sense as our well-being.

But it's interesting, as we think about moving toward a more energy-conserving stance as a nation, to take the position that the conservatives do. We should try to get back to the good old days. If you look at the rise in energy use in this country, you see that in the early 1960s we used about half as much energy per capita as we use today. I am relatively certain that everybody in this room was at least above the age of twelve in the early 1960s, and I think all of us can remember that we had a good number of comforts then and material and nonmaterial goods that went toward making the good life. Therefore, I think we ought not to fear conservation but see it as a challenge to our American ingenuity to meet changing circumstances in an innovative and a creative way. Thank you.

7. RESIDENTIAL ENERGY CONSERVATION STRATEGIES IN THE EAST SOUTH CENTRAL REGION

Eric Hirst

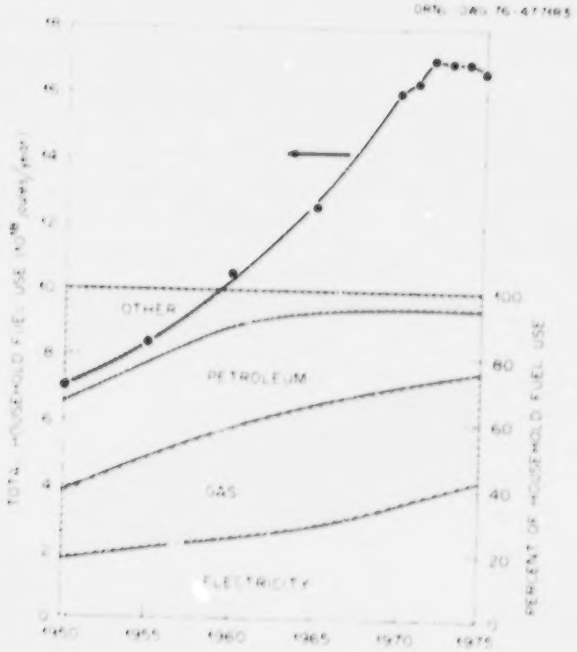
Madam Chairman Nelda Harrell: Our next speaker is Dr. Eric Hirst. Dr. Hirst is a research engineer in the Energy Division at Oak Ridge National Laboratory (ORNL). His research deals with engineering and economic issues associated with energy uses in the residential sector. He has also worked for the Federal Energy Administration in Washington. As a matter of fact, he got started in this area, energy conservation, because of Dr. Jack Gibbons. He worked for Dr. Gibbons at ORNL and also again when he went to Washington. Now he has come back to ORNL. Even though Eric is not a native Tennessean, and is from the South, he says that he really likes the South and intends to stay because of his great interest in outdoor sports.

He has had many publications that have dealt with energy conservation, energy environment issues, environmental education, and the engineering aspects of thermal discharges from power plants. We are very glad to have Eric with us this afternoon. He will be speaking on "Residential Energy Conservation Strategies in the East South Central Region."

Dr. Eric Hirst: In a real sense, what I say this afternoon will follow on from what Jack Gibbons said this morning about Federal programs, and from some of the things that Grant Thompson just talked about. The focus of my talk will be on residential energy use and conservation programs as they apply to the East South Central Region. The key point that I am going to try to make this afternoon is that these conservation measures can save a great deal of energy over the next 20 or 25 years for the region, and they can also save a lot of money for the region's households. Although I think there are a lot of reasons for developing conservation programs, such as environmental costs and the need for conservation ethics, I am not going to talk about those things. I am going to talk about that which is probably the greatest driving force in America — the profit motive, the dollar — and how these programs can really help save consumers money.

Before I get into that, I want to give a little bit of historical perspective on how energy has been used in the residential sector and then talk about some very specific conservation measures that could be implemented. This slide (Slide 7.1) shows national residential energy use from 1950 to 1975. What I want you to look at is this curve which shows total national residential energy use from 1950 through 1975. You will note that from 1950 to about 1970 energy use increased very steadily, at about 3% to 4% a year. In 1972, though, things changed, and they changed very dramatically. Between 1972 and 1973, between 1973 and 1974, and between 1974 and 1975, residential energy use declined. So it's a very sudden reversal of a long-term historical trend.

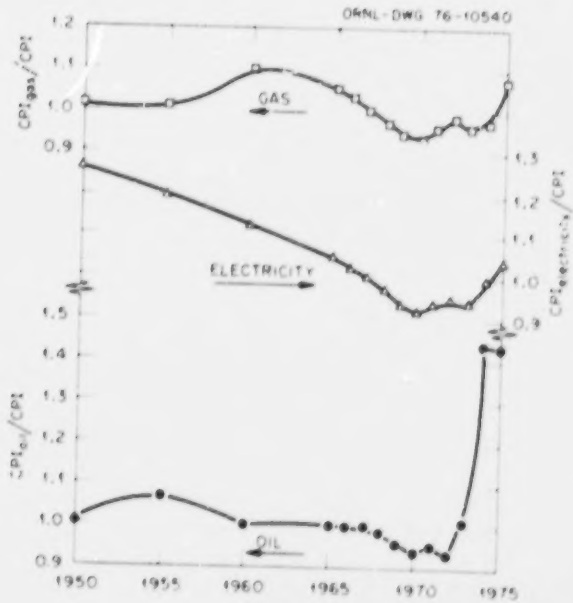
If you like to make projections on the basis of semilog paper, as Ed Berlin suggested this morning, it's very hard to do, because if you look at the first period then residential energies would go up through the ceiling. If you look at the last few years, it might go down through the basement. Where energy use lies between those two limits, I think, is in very large measure dependent on what we and our Government decide to do over the next 10, 20, 30 years.



Slide 7.1

Perhaps the key determinant of this sudden reversal in the trend of energy use was price, and price was mentioned by several of the speakers this morning, and also by Grant, as being a very important determinant of energy use.

This slide (Slide 7.2) shows for the same 25-year period real prices for oil, electricity, and natural gas to residential customers. The trends are pretty clear. Up until about 1970 prices were more or less stable



Slide 7.2

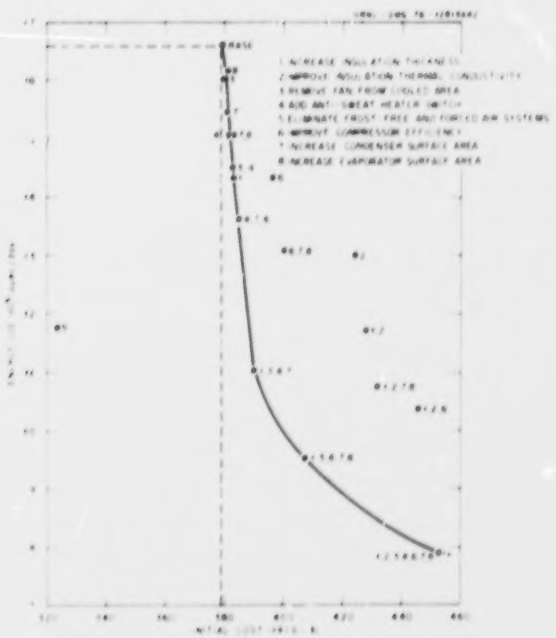
for oil and gas, and for electricity actually declining quite rapidly. After 1970, or somewhere about then, prices began to increase. They increased very dramatically for oil, and less so for electricity and gas. This slide only goes up to 1975, but I looked at the statistics for 1976 and energy prices are continuing to increase. The biggest increase between 1975 and 1976 was in the price for natural gas which went up over 10% in that one-year period.

The interpretation I give to this is that the era of cheap energy is over. Prices for fuels are high now, and they are almost certain to get higher in the future. Grant's point that we don't know what energy prices will be in the future is correct, but I think we are pretty confident about the trend: it's going to continue to be up. Given a future of scarce energy resources and higher energy prices, what can we do?

The next thing I want to talk about is the energy conservation measures that can be implemented in the residential sector. There are two kinds of measures that you can consider. One deals with the technology, the systems that are in place, and involves improving the efficiency of our heating and cooling systems for the structures in which we live. Making these technological improvements is appealing because it doesn't involve lifestyle changes. It doesn't require us to change the way we behave. It does require us to change the way in which we purchase equipment and structures. One disadvantage of relying solely on technological measures is the long lead time that is involved. Typical household equipment lasts 15 to 20 years, and structures last 50 to 100 years, so it takes a long time to roll over this stock of capitals that we use.

The other kind of measure is behavioral change, in which we change the way we use existing systems of equipment and structures. For example, this might be setting back thermostats at night. Jack Gibbons mentioned that this morning. Here there are no capital investments required, so the change can occur very quickly. On the other hand, it does involve some change in the ways in which we behave, and that might for some people be considered a lifestyle change, perhaps a major lifestyle change.

I would like to give a couple of examples of these types of measures, and then see what they imply for the East South Central Region. This next slide (Slide 7.3) shows the relationship between energy requirement and consumer purchase price for refrigerators. As you can see, at the top there is a point

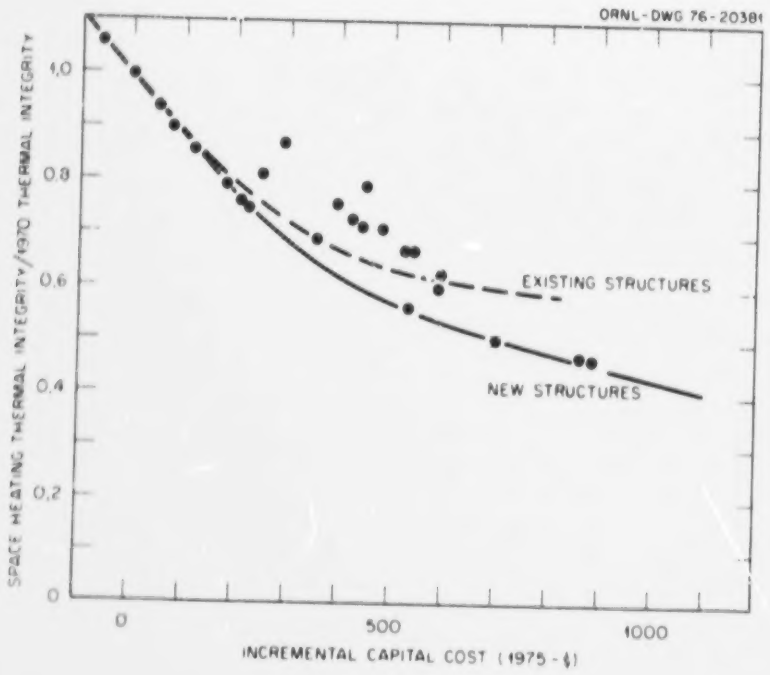


Slide 7.3

called base, which is a typical residential refrigerator sold in 1975, a 16-cubic-foot refrigerator-freezer with the freezer on top. Each of these points represents an alternative design for refrigerators that involves lower energy requirements. So, as you go down you are using less energy, that is, the refrigerator is becoming more efficient.

But in general, making these design changes, adding insulation, increasing the heat exchanger surface area, adding a better compressor, is going to increase the capital cost, so you have the classic dilemma of trading operating costs for capital costs. The question is, where on this curve do you want to be? As Grant mentioned in his talk, some of these improvements can be made very cheaply. For example, going down to a point where you cut refrigerator energy use by about a third involves an increase in capital cost of only $20. So, the payback period for this kind of improvement is very rapid. That is, the investment that you have to make in the improved refrigerator gets paid back in a matter of months. This seems to be generally true, that residential equipment is so poorly designed relative to today's energy prices that you can make enormous improvements in the efficiency with which these systems operate at very small capital costs.

The next slide (Slide 7.4) makes the same point with respect to structures. Here the vertical axis represents the amount of energy required for space heating for a single-family home, and the horizontal axis represents the extra capital cost to this single-family home by making the design changes of adding more insulation to the walls, the ceilings, and the floors, adding storm windows and storm doors, and things like that. Here, again, you have a very large energy savings in space heating for costs on the order of a few hundred dollars. If you buy a house for $30,000 or $40,000, then $500 is really very little to pay if that is going to cut your annual heating bill by one-half. You may be paying $200 or $300 or $400 per year for heating.

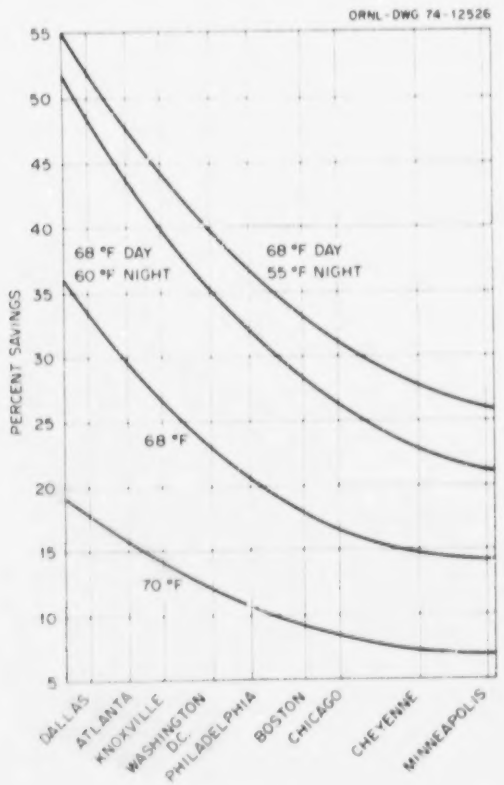


Slide 7.4

I also show the relationship between energy requirement and capital costs for existing structures. This would involve retrofit. Here you have to pay a little bit more, because the house is already built. But even for existing homes, there is a lot of potential for saving money by adding such things as attic insulation or storm windows. These are a couple of examples of the kinds of technological changes that can be made.

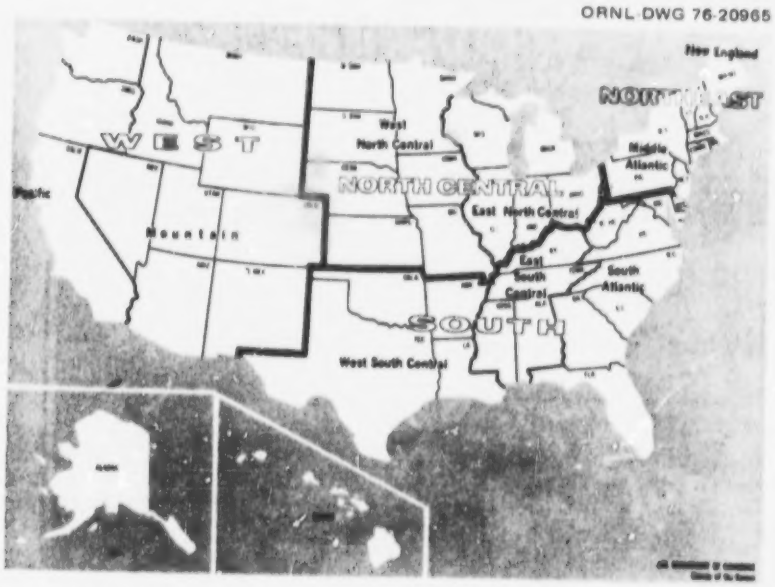
Let's look at one example of a behavioral change. If you were here this morning you saw this slide that Jack Gibbons presented (Slide 7.5). What this slide shows is the percent of energy savings for a winter heating season that you can achieve by turning back your thermostat either 2° or 4°, or setting it back an additional 8° or 13° at night. If you take a typical city like Philadelphia and look at how much you can get by turning your thermostat back to 68° during the day and 60° at night, you see that the savings are about a third. So if you have a winter heating bill of $400, just by setting down your thermostat a few degrees during the day and a few more at night, you can probably save $150. You can even buy your family some very nice sweaters and an electric blanket, and after the first year everything is profit. In the Knoxville area where it's a little bit warmer the savings are even higher, say about 40%.

The point I am trying to make with these examples is that there are a lot of conservation measures in the residential sector which, if implemented, could have large impacts on energy use in the residential sector. My perspective is that these changes do not involve lifestyle changes. We do not have to go back to living in caves. We can still have air conditioning in our houses, we can still have color TVs, and we can live basically as we have before; but we are going to use a lot less energy.



Slide 7.5

Let's look at what these measures might do in the East South Central Region. This (Slide 7.6) is a map of the United States, and you can see the East South Central Region of Kentucky, Tennessee, Alabama, and Mississippi. What I have done is use some models that we have developed at ORNL to evaluate what the impact would be on this region of adopting the federal programs that Jack Gibbons talked about this morning and that Grant talked about this afternoon. Because they preceded me and did such a good job, I am just going to say a couple of sentences about what these programs are for the



Slide 7.6

residential sector. They involve implementation of the Federal Energy Administration's appliance program, adoption of standards for construction of new residential buildings, and some kind of retrofit program to upgrade existing single-family units in the East South Central Region. What I try to address with our model is the effects on the region of ad[illegible]ng these programs. The speakers this morning, and Grant this afternoon, mentioned that these [illegible]f activities are under way. What I have done is to assume that they become implemented, that is [illegible]ederal government does a conscientious job of implementing them, the state governments take their role in terms of a state conservation plan.

Here is my estimate of what effect that would have (Slide 7.7). I looked at the three different kinds of programs—appliance standards, thermal standards for new construction, and retrofit for existing structures—and evaluated the cumulative energy savings in quadrillions of Btus. It's an enormous number over the next 23 years, between now and the year 2000. As Grant mentioned before, the biggest savings come from appliances, and upgrading existing structures and improving new structures provide roughly equal amounts of energy savings.

This next slide (Slide 7.8) shows how the economic effects of the program occur. Here I am adding to the energy savings what the benefit and the costs are. The benefits are the reduction in fuel bills, the dollars you shell out every month to your local utilities. The costs are the extra capital for installing new equipment, improving equipment, and upgrading the thermal integrity of your structure. What I have evaluated here is the benefit cost ratio, which is a ratio of the reduction in fuel bills to the increase in

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Cumulative (1977-2000) effects of federal conservation programs
ESC region

	Cumulative energy savings (QBtu)
Appliances	1.6
New structures	0.5
Existing structures	0.4
Combined program	2.4

Slide 7.7

ORNL-DWG 77-3853A

Cumulative (1977-2000) effects of federal conservation programs.
ESC region

	Cumulative energy savings (QBtu)	Cumulative economic effects	
		Benefit/cost	Cost reduction (million $)
Appliances	1.6	1.4	410
New structures	0.5	2.2	230
Existing structures	0.4	2.3	220
Combined program	2.4	1.6	760

Slide 7.8

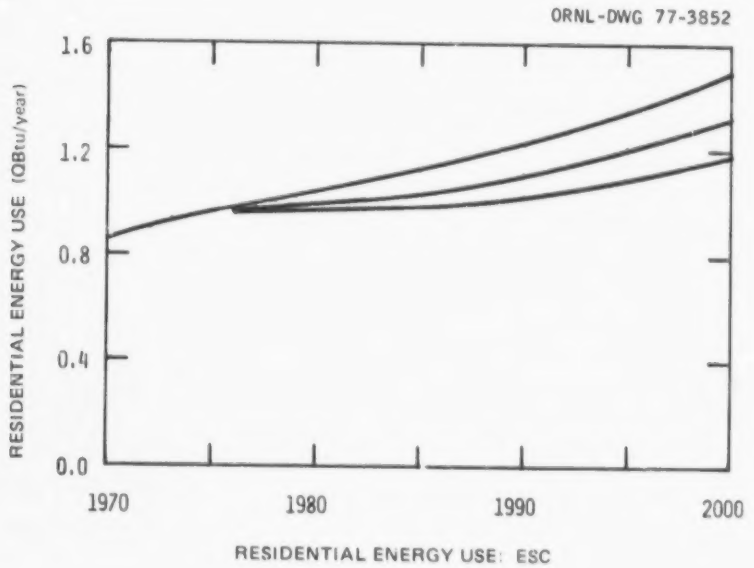
capital costs, and I have used a very high interest rate in doing this. I have used an interest rate of 10%, and that's a real interest rate so it's equivalent to a nominal rate of about 15%. If I had used a lower interest rate which might be more realistic, the benefits would be even greater.

But even with this high interest rate, you see, each of these programs is cost effective, that is, a dollar saved exceeds a dollar spent. For the overall program, the benefit cost ratio is 1.6, significantly above 1. If you look at the total savings for the region, that is, the benefits minus the costs, a total of $760 million are saved between now and the year 2000, in terms of the present worth today. Why, that's close to a billion dollars that can be saved by implementing these residential programs!

If these programs save energy and save money, what would stronger programs do? I think it's important to think about stronger programs. The programs that we are talking about today are geared for the energy crisis of the late 1970s and early 1980s; but if you assume, as most people do, that fuel prices will continue to increase, then it's important to look at what might be needed in the late 1980s and the 1990s.

Here (Slide 7.9) I show the total residential energy use for this four-state region, first without any conservation program, second with this combined federal program, and third with my own conservation program, which I am not at liberty to describe. You can see that the federal program has a significant impact on reducing residential energy growth, without in any way affecting lifestyles for the region. The super program, as I call it, has even larger energy savings.

Well, what about the capital costs and the economic benefits of this super program? How do they compare with those of the federal program? This last slide (Slide 7.10) shows that the super program not only has larger energy savings, but it also has larger economic savings. The federal programs that we just discussed would cut energy use between now and the year 2000 by about 8%. My program would save 14%. The energy savings in the year 2000 are larger, because by then you have had more time to affect buildings and structures. The federal program would save 12% in the year 2000. My program saves 21%.



Slide 7.9

ORNL-DWG 77-3851

Conservation programs save both energy and money: ESC region

	Federal programs	Super program
Energy savings (QBtu)		
2000	0.2 (12%)	0.3 (21%)
1977-2000	2.4 (8%)	4.2 (14%)
Cumulative economic savings, 1977-2000 @ 10% (million $)	760	1700

Slide 7.10

Grant talked before about the kinds of energy savings that would be possible, and the figures he used were about 30 to 50%, which is quite a bit higher than what I have here. The reason is that the reference level that I compare with involves a growth rate in energy use that is much lower than the historical growth rate. The reason I use a reference projection that is lower than historical is that I am convinced higher fuel prices and slower population growth will have a significant dampening effect on residential energy use in this region, as well as in the nation as a whole. So actually the energy savings relative to historical growth are quite a bit higher.

We talk about the economic savings for the federal program as being about $760 million. For the super program they increase all the way to $1.7 billion. So it is clear that there are significant energy and economic benefits of adopting the kind of programs that are now on the books—not yet implemented but on the books. There are even larger energy benefits and economic benefits of adopting tougher programs.

Let me summarize. This last slide (Slide 7.11) shows my conclusions, that is, that these kinds of conservation programs can play a major role in resolving energy problems. They can help resolve energy problems in two ways. One, they save energy; second, they cost less to implement than alternative programs that would increase energy supply.

My first conclusion is that residential energy use will grow much more slowly in the future than it has in the past. Historically, residential energy use grew at about 3½ to 4% a year. My reference projection is on the order of 2 to 2½% a year. So there is a significant reduction in energy use projected because of changes in fuel prices and changes in population growth.

But I think we can save a lot of energy even beyond that. That comes about because existing federal programs can cut residential energy use in the year 2000 by almost 15%. It's 15% for the nation, and it's a little bit less, about 12%, for the region.

These conservation programs not only save energy but they also save money for households. So there is that nice little Yankee motive—the profit, the dollar—to implement these programs. As a homeowner I don't really care about national energy problems; but I do care about my household budget. So it's very nice that the personal economic incentive coincides very well with what I think should be our national energy policy.

My last conclusion shows that I am an energy conservation optimist. It is that stronger programs, that is, programs that go significantly beyond what we now have on the books, would provide additional benefits to the country and to the region, in terms of both energy savings and additional economic benefits.

ORNL-DWG 77-5215

Conservation can play a major role in resolving energy problems

1. Residential energy use will grow more slowly in 4th quarter of century than during 3rd.
2. Existing federal conservation programs can cut residential energy use in 2000 by 15%.
3. These conservation efforts also save money for households.
4. Stronger programs would increase both energy and monetary savings.

Slide 7.11

I want to remind you that in each of these cases I have made no assumptions about changes in lifestyle; in the model runs I do not assume that people move out of big, single-family homes into tiny apartments. I do not assume that houses are constructed underground, nor do I assume the implementation of new technologies. I do not assume total energy systems; I do not assume solar systems. I do not assume even technological advances in what you might call typical conservation systems; for example, I do not assume implementation of anything like the ACES house. These are the kinds of energy savings and economic benefits that can occur with just present-day technologies.

My feeling is that over the next 20 or 25 years. ERDA's programs and other programs will have large research and development benefits that will affect energy use projections. I also feel that other measures will take place, like solar programs, and some of the institutional issues that are associated with the use of waste heat and total energy systems may be resolved. These things lead me to suggest, although I don't show it here, that it is perfectly feasible, and I think desirable, to have us approaching zero energy growth in the residential sector by the end of the century. I think we can easily approach zero energy growth in the residential sector, again without any real lifestyle changes on the part of households. Thank you. Do we allow questions here, comments, insults? Jack.

Mr. Jack Gibbons: Eric, you used a very conservative real number for interest rates. You used the number of 10%, which many people would argue is extremely conservative. What happens to the options and the cost-effectiveness of further changes, and therefore decreases in energy demand, if you allow, say, a 4% real interest rate?

Dr. Hirst: Well, if you had a lower interest rate, the economic benefit could be significantly greater. If you think about mortgage interest rates in terms of real dollars, they are about 4%. Today you buy a mortgage at 9%; but inflation is about 5%, so it's clear, as Jack points out, that I am using a very cautious interest rate. I do this so that the pro-growth proponents can't really criticize me. I mean, I don't think anybody is going to argue for a higher interest rate in terms of real dollars and 10%. If these programs are cost-effective at 10%, then at a lower interest rate they are going to be even more cost-effective. So the energy savings could increase even more.

Mr. Gibbons: But as someone concerned about an energy policy, rather than taking that good news in terms of a faster payback suppose I would like to take it in terms of more options. So that whatever investment I make I want to have it pay out within the lifetime of the thing I am putting it into, let's say ten years. But if you allow me a 4% real interest instead of a 10% real interest, it seems to me that I then take on many more options, and therefore I find my demand growth growing even more slowly.

Dr. Hirst: That is definitely true.

Mr. Gibbons: The issue is, how much more slowly?

Dr. Hirst: You can save much more energy. When I come back next year, I will have some answers on that. Fritz.

Dr. H. F. McDuffie: I need help! I recently installed one of these heat pumps at my house, and I see this great chart that you have that shows how if I let the temperature way down at night I can save a lot of money. But the minute I start to heat my house back up in the morning, this little thing that is not very clear on here cuts in, and I get a lot of electrical resistance heating, which costs me through the nose. Now, what advice can you give me to permit me to heat my house up in the morning without running into expensive heat?

Dr. Hirst: The point Fritz raised is a good one. It is that the slide I showed assumed that the efficiency of a heating system was the same at 7:00 in the morning when you were turning it on as it was at 10:00 at night. For a heat pump that is not true. As Fritz points out, when you turn on your heat pump at 6:00 or 7:00 in the morning, you are using resistance heating rather than the heat pump that is twice as efficient.

Ray Ellison and John Moore's group at the Laboratory did a very careful look, exactly as this slide has done, at the energy effects of night setback for heat pumps. They found that the energy savings were significant. The savings are not quite as large because of this resistance heating effect, but they are definitely positive. So my advice would be to turn down your thermostats.

Dr. McDuffie: I will persevere. Thank you.

Dr. Hirst: Well, I guess I handled everything. Thank you.

8. STATE ENERGY PROGRAMS IN KENTUCKY

Damon W. Harrison

Madam Chairman Nelda Harrell: Our next speaker is Mr. Damon W. Harrison from Kentucky. He is a native of Kentucky, holds a degree in economics from Western Kentucky University, and did his graduate work at the University of Kentucky. Most of his career has been spent working for the State of Kentucky. He served in the Unemployment Compensation Commission, Department of Economic Security Employment Service. Mr. Harrison has served as Director of Research in Industrial Planning for the Louisville Chamber of Commerce. Then he went back to the state as Director of Research and Planning for the Department of Commerce. In 1971 he became Commissioner of Commerce; in 1975 he was appointed Commissioner of the Kentucky Department of Energy. We are glad to have Mr. Harrison with us today, and he will be telling us about "State Energy Programs in Kentucky."

Mr. Damon W. Harrison: Most of my life has been spent in the state government, and I am going to talk about energy programs from the viewpoint of state government. I have been around state government during part of the administrations of the last ten governors: two Republicans, eight Democrats, and three different flavors of Democrats. This record does not prove that I am smart; it only proves that I am durable, and one has to be durable.

Events of the past several weeks have created varying degrees of crises in a number of states in the country and have put rather severe strains on state energy programs. It's a good time for us in the states to stop, review the situation, and look at our programs in terms of their adequacy for the years ahead.

Today I want to talk to you about Kentucky's energy program. I do not offer this program as a model for any other state. Because of a wide range of constitutional, statutory, structural, and historical reasons, Tennessee might not be wise to have exactly the same energy program as Kentucky. But I would suggest that any state developing an energy program look at the needs of that particular state. The program developed should have two priorities: it should meet that state's needs first, and it should cooperate with the federal government and seek federal money second.

Before I get into some specifics, I want to give four bits of information as a backdrop. In any state, these four things are going to do a great deal to determine the form and the size of an energy program.

First, in Kentucky we have a very strong governor. He is the boss. He is seldom challenged in the legislation that he takes to the General Assembly; he seldom fails to pass his budget. The governor that I am working under, Julian Carroll, had a tough time. Out of 138 votes on his last budget, he lost, I think, one. With that kind of strength from the governor—and this isn't true in all states—if a governor decides the state needs an energy program, it is likely to have an energy program. For some states, unfortunately or fortunately, this situation does not exist.

Second, in Kentucky both Governor Carroll and his predecessor, now Senator Wendell Ford, were extremely knowledgeable about energy. It is great help to have a boss who will let you alone but still understands what you are trying to do. Third, Kentucky happens to be in good financial condition because we put a severance tax on coal a few years ago. We should have had it 50 years ago. We are in

good financial condition, and the governor and the General Assembly are willing to appropriate moneys to be used in energy programs.

Fourth, although a number of agencies have a considerable involvement in energy, the personalities involved and the lack of any dedicated empire builders make it fairly easy to coordinate an energy program within what appears at first to be a fragmented approach.

Kentucky's energy programs are very broad in scope and numerous. I always look beyond my own little Department of Energy; I have to look at the broader picture. But later on I will put a little more emphasis on the two programs that are totally devoted to energy in Kentucky: the Department of Energy and the Energy Research Center. Our program is not centralized. I don't think it will be. But because of historical accident, because of certain statutes, because of the attitude of certain agencies toward their role, and simply because of the wishes of the governor, we have a pattern which works fairly well for us. Our Department of Energy looks at the short-range supply, demand, conservation, contingency plans, and siting problems. Our Center for Energy Research looks at the longer-term problems of energy research and development and at new sources of energy, particularly coal.

Our Public Service Commission is a five-member body which views its role as quasi-judicial. It does not like to initiate new ideas; it prefers to respond to problems put before it and to react to ideas of other people. There are some states that have aggressive public service commissions or public utility commissions, but ours plays a more passive role.

Our Department of Natural Resources and Environmental Protection obviously has a strong role in energy, because it enforces the air and water and solid-waste pollution regulations. It is also the agency that gives permits for strip-mining and enforces reclamation of strip-mined land. We do have a strip-mining reclamation law that works well. We are favoring, not opposing, the federal legislation; but we are trying to get amendments to take into account peculiar situations in Kentucky. We looked at our reclamation program and decided that it was a dirt-moving program. Moving dirt involves mainly the know-how of civil engineers. In each of our 18 mining districts, the head man is a civil engineer, a situation which makes a great deal of sense.

Then we have a Department of Mines and Minerals, which is the state's safety enforcement agency for mining, but I don't know how that relates to the Federal Safety Agency; I have never been able to figure it out from news accounts. This department also regulates oil and gas production.

Here then are the major agencies in Kentucky that have some important involvement in energy. Obviously there are others, but these are probably the key ones

Now let me be more specific about two of these agencies. First, the Kentucky Department of Energy is a statutory department funded with about half a billion dollars a year in state funds. It has a staff of 23 people and is by far the state's smallest department in number of personnel. We set out to provide enough state money and personnel to carry out a basic energy program that we considered necessary for Kentucky, regardless of whether we ever received another federal dollar.

Fortunately, the Department of Energy does not have any enforcement powers. I say that because I have all of the instincts of a dictator. We have no enforcement powers, but we have a statutory mandate that is very broad. It covers supply of and demand for energy, contingency plans, conservation, and gives us a role in almost anything that involves energy. Because of this mandate, we have a broader responsibility for almost every phase of energy than any other single department. We are the agency responsible for energy conservation and for coordination of energy conservation in the state. We have had the good fortune of wrestling with a very tough supply, demand, and transportation emergency during the last six weeks and we have come through without very many Kentuckians getting cold. We are responsible for Kentucky's energy plan. We are, incidentally, doing the plan in-house, using state agencies that will implement it to do their part of the plan. Since, for the last six weeks, our staff has had

to push aside work on our part of the plan, we are going to have difficulty getting the plan finished on time, even with the delay; but we are the agency handling this plan. In addition, we are charged not to regulate siting, but to see that there is a process for siting, particularly of generating facilities in Kentucky. We are involved very much in that job.

Our agency is not very much different from others, but we do have the authority to intervene before our Public Service Commission. We are encouraged to intervene. In every curtailment plan for natural gas filed last year for this winter, we intervened with a contingency plan to use a pooling arrangement for gas of one kind or another to minimize the economic impact of shortages. The contingency plans for natural gas would have worked up to about 60% curtailment for industry; when we went to 100% curtailment, the plans were useless. We are also encouraged by the commission to bring new ideas to them. For example, they want us to look at a new set of guidelines for natural gas curtailment based more and more on end use.

The Kentucky Center for Energy Reseach is another state agency that carries out or oversees a rather broad research and development program and a coal conversion demonstration project program. As one would expect, in research and development in the State of Kentucky our main concern up to now has been coal, because that is our greatest energy resource. For its research and development program the Center has $2.6 million this year in state funds and will have $4 million next year. When the weather clears, we will be moving into a new 54,000-ft², $4-million energy research building.

The research and development for the Center is not carried out by the state employees; rather, the Center contracts with the Institute of Mining and Minerals Research at the University of Kentucky to operate the research and development program. The Institute in turn contracts with other institutions in the state that have an interest in and a capability for research and development. In this way we have an extensive state-supported research and development program which deals with many aspects of coal. I will mention a few aspects of this program. If anyone wants more detail, he can write and ask for a report.

The program touches on coal reserves, reclamation, better methods of mining, conversion of coal, and cleaning of it through sulfur removal. It touches on almost everything involved in the mining, transportation, and use of coal, including the training of people for the industry. Training is a big problem. To handle the industry's expansion we have training programs going on at three or four 4-year universities, at three or four community colleges, and at a number of vocational schools aimed at meeting the future needs and today's needs of the mining industry. It is a good program. It takes state money; and it requires courage for a governor to ask for money to go into a program like this. But it's going to pay off. The Center's coal conversion demonstration project has authorization from the General Assembly for the use of $50 million of state money to match federal and private moneys for coal conversion projects. This is quite a bit of money for a state which is far from the wealthiest in the country to commit. I think $8 million or $9 million has been appropriated; the rest will be bonds or future appropriations. But we have shown that we are willing to spend for research.

In the demonstration project, several things are going on. We have one project that involves char; we have another project on the solvent refining of coal, which involves bringing it to the granular form. We have the country's first coal liquefaction plant going and headed toward demonstration size. This plant, located at Catlettsburg, Kentucky, uses an H-coal process. Ashland Oil, ERDA, and the State of Kentucky are all involved in the project. We have three low-Btu gas projects approved for the state, and we have had near-misses on a couple of high-Btu projects. On one of them we certainly had the superior proposal. These demonstration projects give some idea of the breadth of our research program.

Obviously, within certain elements of this program and certain elements of the Department of Energy there is a chance for overlap and duplication; but we have kept this from happening. The

administrator of the Center for Energy Research and I have set goals and objectives for both agencies, compared them in every possible area of overlap, and drafted a memo which assigns responsibilities in all of those areas. This arrangement is working quite well.

We have added another new feature in our program, almost by accident. About a year ago many environmental groups became very concerned about the future use of the Ohio River, particularly for power plant sites. Then the announcement that a nuclear plant was proposed at Marble Hill, Indiana, 30 miles upstream from Louisville and just across the river from Kentucky, brought this concern to a fever pitch. Out of this sprang an EPA-funded study of the future needs for power and the future site possibilities in the valley, a study involving seven universities in the states of Ohio, Indiana, Illinois, and Kentucky.

The governor of Kentucky decided that he needed an in-house committee to advise him on the nuclear plant, which we opposed because of the availability of coal, not because we are against nuclear energy per se. So he created a committee called the Policy Advisory Committee on Energy. This committee set out to develop a better method of projecting future needs for electricity, of looking at statewide needs, and of reviewing the applications of various utilities. This committee is also looking at every potential major site along our rivers. These sites, which we are screening for environmental and other characteristics, are to be used for power plants, coal conversion plants, or other major industrial purposes. We are trying to project the potential locations of these kinds of facilities so that we will be able to balance out supply and demand. We may use a site acquisition program like Maryland's.

Then the governor wanted to ask other states to work with him on plant siting, and he invited the governors of West Virginia, Ohio, Illinois, Indiana, and Kentucky, and representatives from TVA to go over these problems with us. They agreed to join us. However, there were two new governors who were faced with the energy problem about eight days after being sworn in. Thus our meeting has been delayed, but we will be looking jointly at the needs of the valley, at ways to project demand, and at ways to evaluate sites. We hope to develop methods different from those of the EPA, in order to provide a balanced approach.

This committee, which started out to project future needs for electricity, is evolving into a fairly effective mechanism to integrate all energy activities in Kentucky. This committee is going to be the group to push forward with a good contingency plan for next winter. The plan will involve many schools, transportation agencies, disaster agencies, public welfare agencies, energy agencies, and so forth. We hope to have a good plan by next winter, but we don't want to have to use it. This committee ought to push for a state energy policy that brings out the conflict between energy, environment, and economic growth. This energy policy is one place to show that compromises may be needed and that such compromises should be debated in the public forum.

As a state which is not rich but which is willing to do something to help itself in order to utilize its greatest natural resource, coal, Kentucky is making advances and is trying to make more energy available for other states. There are some lessons here that other states may learn, although just because we have a working program in Kentucky does not mean that it will work in Tennessee. I look at another state's program and borrow some things, and they do the same to me. But one state should not adopt another state's entire energy program.

It has been good being with you. I am sorry I missed some other speakers, particularly Representative Thornton last night, a man I admire greatly. If you have any questions, I think I have a few minutes to answer any that I can handle safely.

Mr. Grant P. Thompson: I want to compliment you first on the way that you are developing your state program in-house. That is atypical; most people seem to be using consultants, which is a good way to negate the advantages of state programs. I am interested in how you came to the decision to develop a

program in-house and what kind of public participation there has been in the development of the program?

Mr. Harrison: We made the decision because we had staffed about 20 very capable people. We would have had a couple more, but we are literally out of room. I didn't think I could go to the governor and say, "Look, I can't do this job; I can't do the total job," so we made the decision to do what we could and involve other departments. For example, the Department of Transportation is handling carpooling, our state fire marshal is handling lighting and thermal standards, our Department of Finance is handling state purchasing. I am getting the Agricultural Extension Service involved in a public awareness program aimed at homeowners. In short, we decided that we just had too good a staff to go outside. Rather than have somebody bring me a plan and say "Here is your plan," I would rather involve the staff and other departments and let it be their plan.

Concerning public involvement, we have a 35-member advisory commission which we keep involved. We summarized what we were going to put in the plan; we don't yet have the details of the plan. The elements just mentioned are going to be considered, although all of them may not be part of the plan.

I sent this plan to 800 organizations, groups, and individuals in the state—every environmental group, every trade group, the members of the commission, and on and on. I asked them to comment and then asked them, "Do you think we should have a public hearing if time permits?" If we have time and we don't get caught in a deadline, we will have a public hearing.

In any event, as we implement many elements of this plan, particularly our lighting and thermal standards, we will have public hearings. There is going to be a broad public involvement to the extent that we can do it physically. We are not hiding anything; we don't want to. We want it out before the public. We are getting back some pretty good comments from the 800 so far involved and we intend to keep involving the public.

Mr. Norbert J. Ackerman: I read that the governor of Kentucky gave some congressional testimony—I think it was back in November or December—about projections of the impact on the highways in Kentucky from the transportation of coal. Is that coordinated through your office or through the Department of Transportation, and what are the projections for the next five to ten years?

Mr. Harrison: Fortunately, that projection is being handled by the Department of Transportation, which has 7,000 employees as opposed to my 20. The projections state that billions of dollars will be required to repair the roads so that they can be used to move the coal. And who knows what this winter has done to them.

One has to explain this. Although a lot of Kentucky coal is moved by rail, 70% of Eastern Kentucky coal at one point or another moves by truck. It goes from the truck to the tipple to the rail car. Unfortunately, it is practically impossible to enforce some of the weight limits; many times the county judge, the man enforcing them, or the sheriff owns a part of the operation that you are hauling the coal from. It is difficult to get a conviction to keep them from breaking up the roads. But then these roads were not built with the highest standards. With 80% of our coal going to other states, we should not have to pick up the entire burden of the road bill, which runs into the billions of dollars. We may not get any federal money. But this kind of problem will be facing many states developing their energy resources.

Mr. Thompson: Are you including these costs as part of the cost of energy within the state of Kentucky, since you are so heavily dependent upon coal for your electricity production?

Mr. Harrison: No, we are not adding them in, just as they are not getting added in by any other state that uses coal. Road damage is a real cost of producing coal and electricity. In fact, there is a fair chance that we are subsidizing the lights in this room, but we have not factored it in. If we did, if we had absolutely free competition in the sale of coal and we could bill this in the price everywhere, in coal or whatever, the cost would go to the consumer, obviously, because we are the ones that use it.

Mr. Thompson: Are you saying that, because of the recent bad weather, you can project in the short term that you are going to have some shortages of coal transportation capabilities?

Mr Harrison: The highway shortage will not be worse than other transportation shortages. If coal production increased by 20 to 25% in Kentucky, we would have a real transportation problem, not only for the roads but for the rails. The rail beds are in atrocious shape. There are many lines where the speed limit is 5, 6, or 7 miles an hour; if trains go any faster, they will turn over. Then there are transportation constraints on water, with dams jamming up the Ohio River. We are not going to solve all of these transportation problems in just a few years. If we are going to double the production of coal, we had better look also at some of the other problems including manpower, which is a real one. I do not know if we could double coal production.

We ought to mine all the coal that we need, but I don't see any great virtue in just saying, "My God, let's triple the production of coal, let's rip the land and just make a few more millionaires, and let's forget that 250 years from now somebody's children's children's children might need this coal." However, I am optimistic; I think perhaps we will survive that long. Some of my colleagues in Kentucky would like to mine all our coal next week if they could, but I think we ought to do what we need to keep a healthy industry, a healthy area, and meet our obligation, not only to Kentucky but to the rest of the nation.

9. THE BROKERAGE APPROACH TO PUBLIC TRANSPORTATION

Frank W. Davis

Madam Chairman Nelda Harrell: I have had the privilege of hearing our next speaker before and I think you will be very glad that you stayed around to hear this presentation because it is excellent.

Dr. Frank Davis has a broad background in industry, marketing, public finance, and economics to bring to his assignment as associate director of the University of Tennessee Transportation Center. Frank holds degrees from Virginia Polytechnic Institute, Brigham Young University, and Michigan State University. He has a very varied background. He has been a high school teacher, a plant engineer for Roller Bearings Company, and has worked with business data processing systems for Honeywell. He has served on many professional committees, including the Knoxville Transit Authority Board and the Office of Technology Advisory Board, which is concerned with the role of the automobile in 1985 and beyond. He also has been on the Transportation Research Board of the Urban Transport Service Planning and Development Department, and he is a member of the National Energy Advisory Council for our Energy Expo '82.

Frank has been principal investigator on over a dozen research projects dealing with all facets of mass transit, public transportation, and ride sharing. He consults in these fields with national manufacturers, engineering firms, and federal, state, and local governments. He is nationally known and recognized as one of the experts in this field. The current issue of *Business Week* contains an article about his transportation program; the February issue of *Nation's Cities* also has an article about Knoxville's transportation system that Frank has been responsible for. *Time Magazine* and the *New York Times* have had articles, and *Traffic Engineering Publication* also featured Frank's program.

As you will see as Frank begins to speak, he is a very popular and sought-after speaker in our area. We are very glad to have Dr. Frank Davis with us.

Dr. Frank W. Davis, Jr.: I saw a cartoon the other day in *U. S. News and World Report* that showed an obviously empty college classroom. It showed the lectern stand very obviously empty, and on the blackboard in very large letters was a sign, "Today's lecture, 'Man, Master of the Universe,' cancelled because of the natural gas shortage." So, I think that we are beginning to see a number of different approaches, and perhaps some of the things we thought we had the obvious solution to may need re-evaluation.

When I began work in mass transit in 1970, I was convinced that my role was to go out and convince everybody in the world how illogical they were for not using mass transit. I knew at that time that the only obvious answer to public transportation was fixed rail or the traditional bus system. I have learned a lot since that time, and I have begun to realize that the man in the street has much more intelligence than we frequently give him credit for.

I was appointed to the Knoxville Transit Authority in the fall of 1973. At that time TVA was anxious to start their express buses. We experimented with them; Don Mauldin from the city traffic engineer's office and Stan Stokey were very instrumental in helping. We worked with them to solve some of the institutional barriers.

After spending 1½ years on work with the express buses, we had three or four in operation. They were running with full occupancy; some riders were standing in the aisles. People were paying almost double fares, and we thought we had done a fantastic job. Then we came to some practical realizations of the dilemmas that we were having with the current public transportation system. One, public transportation is not very energy-efficient. For example, even though the express buses were running full from the suburb into the city, they were running empty from the bus barn to the suburb and from the work site back to the bus barn. So, consequently, if a 23,000 or 25,000-lb vehicle that gets 4 miles to the gallon is running without passengers 60 to 70% of the time, you are not conserving very much energy.

Second, you don't necessarily save money by running traditional transit systems. For example, a problem that has plagued public transportation since 1880 has been the peak hour problem. The peak hour problem exists because people go to work basically from 8:00 to 5:00, or 9:00 to 5:00, or from 7:00 to 3:30. They have basic trends. And consequently if a rail system has one train that picks up a load of commuters and takes them in with a work crew and has a second crew that returns the train in the evening with no other use for that vehicle and that crew during the middle of the day, it's extremely expensive. In fact, that is exactly what occurs in mass transit. A crew makes one run in, and then there is nothing for them to do until that evening when they take one run out.

In San Francisco and the Golden Gate Bridge System, the dilemma is that out of their 188 brand-new buses, only 23 of them get a chance to make a second run before the peak hour is over. When you have to pay your drivers union wages to watch color TV or to play pool during the middle of the day, you can't afford to haul commuters that way. Although San Francisco transit system riders pay very high fares, operations for the 250 days per year that the system runs must be subsidized about $600 per rider. And that's expensive.

Then, I realized some other things. A rail system is beautiful. It has superb engineering design. We love to see them operate; I love to have a toy one at home. When you operate your own electric train, you feel powerful and influential as you pull the switches and see it change tracks. But almost half your fuel is put into the construction phase of it, and once you construct it, it does not have the ability to keep up with the needs of a changing society.

So we began to realize that if we were truly concerned about fuel efficiency or costs, we had to get a vehicle that has a low cost per seat. Instead of paying $2,000 for a bus seat, we needed to get in the neighborhood of $500 per seat—a van. The next step was to stop driving empty 60 to 70% of the time. We needed a vehicle that could park in the residential area in the evenings and at the work site during the day. We also knew that to make it economically viable, we had to get a vehicle that the people could drive themselves because it's hard to pay a driver $12,500 a year, which is the going rate here in Knoxville. We realized that we had to have something that would get fairly high fuel efficiency for the number of people carried. We also had to have a vehicle that was small enough so that it didn't add a half hour or an hour to the person's trip to pick up and discharge people.

We chose the van as an adjunct to the most popular form of mass transportation; the most popular form of mass transportation in the country is the carpool. The carpool carries at least six times nationally what is carried on mass transit. That has been without effort on anybody's part. We have purchased many thousands of buses for mass transit—in 1964 we had about 50,000 buses and in 1977 we have about 50,000 buses, though they are newer buses and they haul fewer people.

We experimented with a number of different approaches. We realized that private bus companies could do extremely well if they were not locked into labor agreements that are required for federal funding. Anytime you get federal funding for mass transit, you agree to several things: (1) you will never lay the people off; (2) if you do they get one year's severance pay or you will guarantee their salary level for six years. There is now concern that there should be some protection for private companies in this area.

In putting all of this together, we decided the best approach was to make more efficient use of the equipment and the vehicles that we already had instead of running out and buying new ones. It's nice to see vehicles with your logo on them, but unfortunately we have to face realities. You see, there are more vehicles in this country than we can ever use. That is our problem: we have three seats for every man, woman, and child in the United States. Sixty percent of our people hold driver's licenses. There is no shortage of drivers; we have a problem keeping them off the street because they are too old, they are too young, or they have had too many drinks. There is no shortage of capital. I get phone calls daily from people who want to finance vehicles. All you have to do is go to your local bank, your local credit union, your local lease firm; all of them are anxious to fund them.

There is no shortage of technology. You can get vehicles that have water beds and portholes; you can get vehicles that are 25 or 30 ft long that can carry launches or yachts behind them and can sleep 12 people. You get vehicles that will carry 2 people and get 50, 60, 70 miles to the gallon. You can get three-wheel vehicles, two-wheel vehicles, big Peterbilts with sleepers in them; you can get a wide range of vehicles. It's not technology!

The problem is putting it together. We first decided to get the vans and to get people riding together in what we called an overgrown carpool. Then we found out it's against the law. You see, the Public Service Commission was set up in 1930s to regulate transportation. There are only two types of transportation: (1) for hire transportation, which is basically Greyhound, Trailways, and city transit systems, with a few cabs thrown in, and (2) private transportation. To protect public transportation, it was illegal for just anyone to haul people and charge anything for it. And oh, did we have problems there.

We went to the Public Service Commission. They said, "We love you; we think you are doing a great thing. We realize that we had more buses serving the Alcoa Aluminum plant in 1945 than we have in the whole State of Tennessee today. We realize the majority of the cities in Tennessee do not have service of any kind, but we can't let you operate because it's against the law. According to the way the law was set up, you have two options: you can change the law, or we can have the judge tell us whether our interpretation is right." We approached them last Thanksgiving. They said, "Oh, we can rush and expedite a hearing through, and we feel we can have it by May."

So, thank goodness, we had a local delegation here, and some members of the legislature were receptive in getting the law changed. The law now says that anyone with a vehicle containing 15 passengers or less can haul commuters to work without having every route, every stop, and every fare regulated by the Public Service Commission. They did say, however, that we had to get our insurance approved. That became another problem.

We found that as soon as you file for insurance with the Public Service Commission, they assume that you are a common carrier and your degree of liability goes up, and no insurance company will cover you. We spent the last six to eight months working with the insurance industry, and we think we have those problems largely resolved. We are mailing out a letter to over 1300 insurance companies next week bringing forth some new regulations on insurance that will make a tremendous improvement. Basically, anybody carpooling to work will get the same insurance you get on a private automobile whether you have a van, station wagon, pickup truck, or carpool.

We then had to sign a labor agreement with out transit system because no money can come for public transportation in the Knoxville area unless one union signs off on it. As a consequence, we make sure that we don't operate any vans unless the origin or the destination is outside the service area of the transit system, so they can't say that we compete with them.

There have been a number of other steps. For example, we found that whenever people pool together, they must have a place to meet and park their vehicles so that they can share rides together. We located over 80 churches that have volunteered to let people park in their lots.

But we found out something else when we tried to get the state to make signs. If you want people to park somewhere you have to give them permission, and a sign is the typical way of doing it. But state government can't use public money to put signs on private property. They can go out and buy the land and use the energy to build another lot; that's okay. You can spend $50,000 or $100,000 to build a lot, but you can't spend $35 to put a sign on a lot owned and maintained by a church saying it's legal to park there.

Then we said, "Well, what if we could get that law changed?" And they said, "But there's another problem. If you put up a sign inviting people to park on that lot, the person becomes an invitee, rather than a licensee, and your liability increases because your degree of care has to change." So the church said, "We don't want to take on the additional liability."

"Let's get the law changed so that the state can come in and cover you with an insurance policy," we said.

"Oh, but you don't understand. There is another problem. If anybody gives us reimbursement for any type of commercial activity, we lose our tax-exempt status."

Consequently, we proposed legislation that would say that for any church in the state that would like to volunteer their parking space, the state would put up a $37 sign; the church would not incur any additional liability nor lose their tax-exempt status. A simple thing — we are not talking about big money, but think of the dollars it saves.

We found another problem. One bus company said, "You know, I sure would like to provide service over there." Another company said, "For years I thought there would be a good market into Oak Ridge. I think there is also a good market into the Eastman Plant up at Kingsport, but I'm not willing to take the risk to provide commuter service. You know why? Because for me to get permission to operate I have to have a certificate of convenience and necessity. This means that I have to take a group of people, who indicate they want to ride with me, to Nashville to testify before the Public Service Commission. Then I get the franchise, and I try it for three or four months. If I find that it's not viable or that I'm losing money, I have to repeat the process with the attorney's fees, the legal fees, creating the briefs, going to Nashville, the testimony — and it cost me $5,000 to get the certificate in the first place. Should I want to abandon it, I have to spend that much more to abandon it, and if any of the people who are now riding with me want to protest it, I may not be able to abandon it. I'm not willing to take the risk!"

Is it any wonder that ridership on Greyhound and Trailways is now 17% of what it was in 1943, and that there were more buses serving the Alcoa Aluminum plant in 1945 than in the whole State of Tennessee today? Is it any wonder?

We have submitted 13 proposals like this to the state government, none of which requires any funding. All of them simply state that if you expect somebody to give you something free, you ought to go halfway and not give them additional liability. You could at least put the signs up and bring their liability under workers' compensation. This is a brokerage concept — to find out where there is a demand and where there is a supply of transportation, and then work to eliminate the institutional barriers. It is these institutional barriers that prohibit people from solving their own transportation problems. We don't have a shortage of transportation. What costs a lot of money is for us to try to force people to use something they don't want to use and to force our way through the institutional problems.

After making some modifications, we now have 76 vans operating in Knoxville, Tennessee. That ridership is equivalent to about 10 to 12% of the total ridership on the traditional transit system. We are now carrying about 30% as many people as were riding the entire traditional transit system including Awtrey and B&C, and our vehicles are virtually covering their own costs. The vanpools and private bus companies are covering their own costs completely, and there is no subsidy whatsoever. The transit is a very high-cost way of providing the service; their costs run approximately double what the private

operator's run. Although they are given free buses, a free garage, and a number of other things, they are still under 13¢.

We are now coming up with a computer operation that we had not anticipated but that seemed to stem out of the project, which I feel has a lot of potential. We are piggybacking on a computer in Boston; we have a little cathode-ray tube and a little printer. If anybody calls us up and says, "Hey, my car won't start this morning," or, "It's in the garage, and I would like a ride to work," we can give them a list of people they can phone who have indicated a willingness to share a ride. It takes about half a second to get the computer response. We feel that this has potential, whether you are talking about individuals who want to piggyback rides to little-league football games or to night classes at UT, whether you are talking about formalized carpools that share rides together every day, or whether you are talking about backup carpools for people who are in pools and miss their regular ride.

The Mitre Corporation is working on another concept of piggybacking that is basically a round robin type carpool. After a driver completes defensive driver's training and meets all the other qualifications, he puts a sign on his car that gives his origin and destination. Individuals who have their appropriate pass will stand on the street and hold it up to indicate that they have been screened and are fairly reputable. The first car that comes by that is going to their destination will stop and pick them up; there is an expected fee. With a combination of that system and the computerized system, we could provide the specific transportation that people need rather than running buses up and down the street, hoping that somebody will get on them.

We are now helping the City of Knoxville with one of its problems. You see, Knoxville's downtown business district is faced with limited parking; if parking fees are high, customers are chased away. If parking fees are low, all the employees fill up the spaces. We are suggesting to them an aggressive program of pooling funded, in part, by the employer. A token fee of about 30¢ per person per day would indicate that the employer is committed to putting some money into it. If employers put money into the program, they can assign their employees to peripheral lots, the ones that are one block away. The employees could carpool or vanpool. A driver would drop them off at the front door of their place of work, and then the driver would park the van or the car in the peripheral lots.

That 30¢ a day will cover the cost of parking if it's a four-person carpool, and it will bring the vanpool down to the cost of gas. Then the lots that are close to the businesses would be reserved for customers because customers are what keep your business operating and keep us employed. Consequently, pooling will keep business in Knoxville.

Looking at it on a cost basis, most people don't understand how greatly they are subsidized in their parking. If you have some free land and you hire somebody to grade it, coat it with asphalt, which is another petroleum product, and then paint it, it will cost 60 to 70¢ per space per work day, amortized over a 20 or 30-year period at 7 or 8%. If you build a garage on virtually free land, it will cost a minimum of $2 per work day per space. Even if it's a two-story or four-story structure, that is a fairly accurate cost estimate.

Therefore, free parking is subsidized heavily. The University of Tennessee is going to build a parking garage for which they will pay about $2 a day per space; they plan to collect $5 per month for a sticker, but at least they have revenue from other lots to cover the cost. You can see what good economy that is. Looking back at the downtown situation, for 30¢ a day you could park a car cheaper than you could pave a surface lot even if the land were free. A number of these suggested plans are in touch with the realities of our times. We are not talking about large capital expenditures or the building of vast new systems. We are talking about moving to a simple conservation ethic.

In Knoxville, approximately 42% of the commuters ride in carpools utilizing about 21.5% of the vehicles. There are now 75 or 76 commuter vans operating in Knoxville. We have shown that people will

do it! The next step is to remove the ultimate status symbol. As you know, the ultimate status symbol is a corporation with large smokestacks belching smoke and a sign on the front lot that says "President" with a big limousine parked in front of it. If the number of parking spaces were short and people bid on them much as the union bids on a job, drivers would get seniority by the number of people in the vehicle. So, a vehicle with twelve privates would get reserved parking by number at a military base, while the general coming by himself would park in one of the lower priority spaces. When we realize that the contribution to society and the conservation of energy is more important than the status of the executive driving his large automobile into the smoke-belching factory, we will see a real change in our commuting patterns. I think that the time is here!

Pools sometimes fail because of change in working-shift patterns. A pool of eight to twelve riders is going strong; everybody is excited and happy about it. It's paying its own way, it's saving parking, and then the company decides that they want to change shifts. Those twelve raders are put on four different shifts, and it's amazing what that does to a carpool or a vanpool. By working together and by realizing that energy conservation might be one input into the equation, the City of Knoxville could take the lead in this project. Knoxville now has more vanpools than the next largest city project, which is Los Angeles; we are pleased with that because Knoxville is a little smaller than Los Angeles.

I have a poster here that says, "How to save your company $24,000 in construction costs and 40 parking spaces, $4,000 yearly maintenance of the above, and how to save your employees $24,000, at no cost to you." Lift the flap and you see four vans. Each of these vans uses from 4,000 to 6,000 gallons of fuel a year; I am amazed at the amount of conservation. Some vanpools begin as large carpools, that go long distances, and some vans start without carpools. We have many kinds. We have one driver coming from Dandridge. The young lady drives a VW to North Knoxville where she has left the van at her mother's house. She picks up the van, picks up a full load, and drives to K-25. Now that's a pool!

We have a private pool that goes from Knoxville to west of Chattanooga every day, and that one is loaded. We have one that picks up eight people at a day care center every morning, and they all park their cars at the day care center and pool to work.

There are a number of different types and varieties. It doesn't matter whether it's a pickup truck pool, carpool, vanpool, taxipool. We would like taxis to operate in the pooling mode also, not in the in-and-out arrangement. We feel that this is the mood of the times, and it is a real chance to save energy in the short run. Thank you.

DISCUSSION AND FINAL REMARKS

Chairman Tom Waldrop: This concludes the speakers for today. We have saved part of the day for comments from anyone in the audience and we will be glad to recognize you at this time.

Would you give your name, please.

Mr. Darrell R. Armentrout: I am Darrell Armentrout, TVA. I support individual conservation very strongly. I think these speakers have been very impressive, particularly the presentation on residential savings of 10 to 12%. I am curious to know what the impact on our overall demand for energy over the next 25 years will be through these national conservation programs?

Chairman Waldrop: I think we have got a problem, Darrell. Eric Hirst has gone. Jack, can you answer that?

Mr. Armentrout: The comparisons that I observed in the presentations, particularly the one on residential percentages of savings, just made comparisons to residential consumption or the demand for residential energy. Are there figures that project what the national conservation programs will save in total energy demands over the next 25 years?

Mr. Gibbons: There are so many of those projections, you could just about pick your favorite. The national energy outlook of the FEA, which is published every January and comes out about March, has some of these. There are detailed studies, for instance, of the Energy Policy and Conservation Act, which calls for certain escalated, sales-weighted average automotive efficiency improvements. There are estimates of the impacts of ride-sharing, of intermodal shifts of freight. There was a so-called 300-day study just completed by the Department of Transportation. These are being folded together in the study I mentioned this morning of the Committee on Nuclear and Alternative Systems, and those numbers will be available about the first of July. The National Petroleum Council has finished a study, and I showed just one slide of a summary of theirs.

So, there are many numbers available, and I don't think there are many arguments about what would happen if the law succeeds. You recall though, in the case of the Energy Policy and Conservation Act, that they say we are going to go to a sales-weighted average performance of 27½ miles per gallon by 1985; however, it takes about ten years for that to happen for the entire fleet. At the same time, it may not even happen for the new cars in 1985. It could be that the auto companies would opt to take the penalty, which is a fine, and just pass that fine on to the consumers through higher prices. So just because you have a policy doesn't mean it's necessarily going to happen.

If, however, you do assume that the policy is going to work, then you can calculate the numbers. As I recall, for private automobiles alone, with the numbers as given in the Energy Policy and Conservation Act, the savings in 1985 are already about one quad per year. That is all petroleum, which is the best kind of savings you can have. It gains a lot of momentum by the turn of the century and you have several quads of savings. That does not include savings that could be received from ride-sharing. To calculate the savings from ride-sharing, you would figure what fraction of our gasoline is now used in commuter traffic and inter-urban traffic, then find out what percentage of the riders would probably shift over to the vans, and calculate the numbers. I am sure this has been done in some detail.

The savings are appreciable and for the automotive gasoline consumption they cause a shift from a 5% annual growth rate, which was caused by decreasing average mileage and an increasing average number of miles driven per car, to essentially a zero growth curve of demand for gasoline. The increased number of miles driven each year by the cars will be more than offset by the increased efficiency per mile of the automobile.

Chairman Waldrop: Anyone else?

Mr. Eugene Banker: Mr. Berlin mentioned in his talk the importance of early planning and public awareness in connection with energy projects. It reminds me of our problem on the breeder reactor. I would like for him to comment further on how early, how much before the public hearings that we have now, he would start bringing that kind of public attention and planning into effect? And how would he go about it?

Mr. Edward Berlin: Very, very early. Let me give you the bottom line: really as soon as a utility has a glimmer of expansion plans in its mind. And I believe that for one very strong reason, which you may or may not agree with. When utilities are making decisions about plant expansion—about generation, mix, nuclear versus coal—they are essentially making basic public decisions, and basically using public resources and the public's money. And I firmly believe that the public has the right to participate in that type of quasi-governmental decision making.

What we are trying to do in New York State, and I don't know if it will work, is to direct each of the utilities (seven are privately owned and one is a power authority) to develop a common set of engineering, environmental, and economic guidelines for site selection. They have done this, they completed the task several months ago. Now they are canvassing the state, utilizing those guidelines, for a catalog of potential generation sites. That will be completed by the end of this year.

It is our present intention to hold public hearings on the sites identified by the eight utilities, to endeavor to come up with some kind of priority ranking in terms of the desirability of the sites for power generation, even though these sites will not be used for 10, 20, or 30 years into the future. We will also begin a program in the very near future of on-site monitoring of both water and ambient air quality, so that we may begin to develop a reservoir of information about sites and a list of suitable candidate sites.

You see, when a utility presents an application it may well be that the utility has optimized from its own standpoint in selecting a particular site and a particular generation mode. But this doesn't necessarily mean that they have optimized from the statewide standpoint, and it certainly doesn't mean that they have optimized from a regional standpoint. As a member of a statewide regulatory body, my responsibility, as I see it, is to optimize from the state standpoint, to achieve the greatest social gains at the least social cost. That is why I believe we have to approach siting, generation site selection, and generation mode selection at a very early stage and with a statewide objective in mind.

I know many of you people are concerned with interventions—environmental interventions and consumer interventions—and the fact that they have succeeded in slowing projects down. I fervently believe that the adoption of the types of procedures I have been discussing will in fact achieve expedition. Not only will they achieve expedition, but I think you will see a different level of public intervention. If we construct a mechanism that really allows sincere people to provide intelligent input in a way that they feel can have an effect on the process itself, I think we'll see those kinds of people coming forward. There will be fewer cases of complaints from frustrated housewives (and I don't use the term disparagingly) and farmers who lie down in front of plows so that power lines can't get constructed or who lie down in front of bulldozers on construction sites. These dramatic scenes have been happening for a very good reason—we have frozen people out! I have a basic faith in the ability of people to reason intelligently if we extend to them the common courtesy of a real opportunity to do so. Maybe I am too idealistic, but we are going to try it, and I hope it works.

Mr. Banker: I appreciate your problem and the method you have mentioned very much. I think it is extremely important that we get this information out to people and that we get early public planning. But I recognize that that is a most difficult thing to do. I believe that the Oak Ridge National Laboratory and TVA, in particular, should be aware of this, as well as the University, Dr. Gibbons. They should promote public meetings, something like that old Environment 2000 we tried to start up several years ago, and make the populace aware. They should encourage more everyday people, even country squires and similar people, to come in and learn something about these issues.

For instance, the breeder reactor program was going on in the Laboratory at least a dozen years ago, if not fifteen years ago or maybe more. It might have been well for the people of this area to have been aware of that; maybe we would have had fewer problems on the location there or in other parts of the country. I certainly appreciate this problem. I think that it's a most important suggestion that has been made.

Chairman Waldrop: Any other questions or comments from the audience, that Jack Gibbons or Ed Berlin can answer?

Well, this concludes our part of the program today, and I will turn it over to John Prados.

General Chairman John Prados: Thank you, Tom. I just wanted to take this opportunity to thank those members of the audience who have stuck with us to the bitter end, to thank in particular our distinguished speakers at this Public Awareness Symposium, and to thank the distinguished guests who have been with us today. I would like to express my appreciation to Tom for his very fine work in putting together this program today. I have found it extremely stimulating and enjoyable, and I hope you have too. This concludes WATTec-1977. Thank you for being with us, and come back next year.